ELECTRICAL CONSTRUCTION AND MAINTENANCE

ELECTRICAL SPECIFICATIONS

A manual of Master Specifications and specification writing procedure for electrical wiring systems and equipment.

JULY · 1949

A McGRAW-HILL PUBLICATION

when you're buying fluorescent fixtures

You're on the right track to better lighting when you see this tag on a fluorescent fixture. It means the manufacturer has made use of the industry's finest ballast to assure you of rated lamp life and light output . . . with quiet operation and a minimum of maintenance.

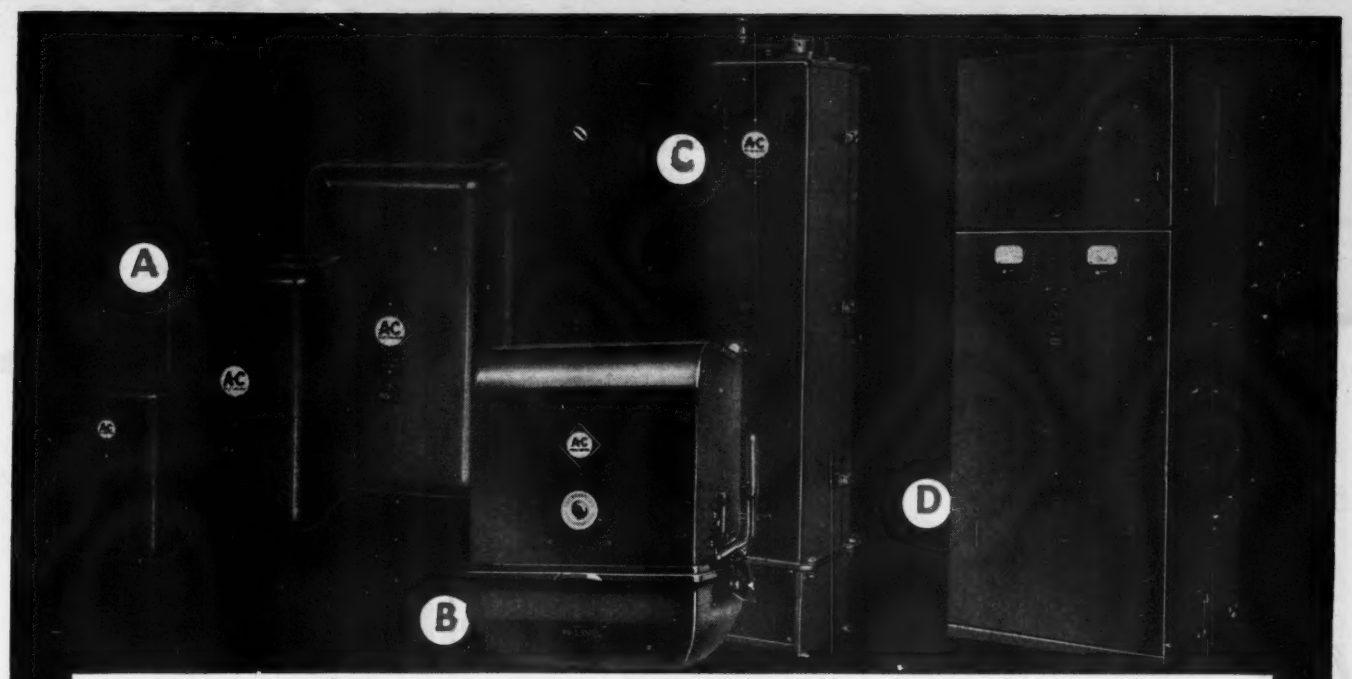
General Electric ballasts are designed, built and tested to get the most out of all standard fluorescent lamps. So for quality and economy in fluorescent lighting, insist on this tag when you're making a purchase—and get the most for your money. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

FLUORESCENT LAMPS, unlike incandescent lamps, do not draw current directly from the lighting circuit. Instead they draw their current through a special transformer or ballast mounted in the fluorescent fixture.

With fluorescent lighting, therefore, the amount of the light you get from the lamp, the life of the lamp, and to some extent the life and efficiency of the fixture itself, depend in large measure on the characteristics of the ballast. Good ballasts mean better lighting.

GENERAL ELECTRIC

412-72



GENERAL PURPOSE — for SQUIRREL-CAGE MOTORS less than 600 hp:

A ACROSS-THE-LINE Full Voltage in a variety of sizes and enclosures.

B FOR REDUCED VOLTAGE STARTING: Manual and Magnetic Auto-Transformer Reduced Voltage Starters, and Magnetic Primary Resistor Starters.

FOR WOUND ROTOR MOTORS: a wide variety of starters: Manual Primary and Secondary, Magnetic Primary and Secondary, Magnetic Primary with Manual Secondary, and Drum Type Reversing Primary and Secondary.

C DRUM SWITCHES for Secondary Control provides either Starting or Regulating Duty.

FOR SYNCHRONOUS MOTORS, starters for motors from 20 to 3000 hp.

D HIGH INTERRUPTING CAPACITY STARTERS for high voltage *Squirrel-Cage, Wound Rotor* and *Synchronous Motors*. These starters have current limiting features. They can be connected directly to circuits requiring up to 150,000 KVA at 4160 to 4600 volts without a back-up circuit breaker.

CHOOSE AN ALLIS-CHALMERS STARTER for *Any* Motor Need

A-2733

☛ YOU GET WIDE SELECTION of starter type, size and enclosure for *each* type motor.

☛ YOU GET DEPENDABLE OPERATION! Allis-Chalmers starters are generously designed, durably built.

☛ EASE OF MAINTENANCE results from *built-in* accessibility of renewable parts.

☛ MANY PROTECTIVE FEATURES! Overload, undervoltage, interlocking and other devices mean greater safety for equipment and personnel.

☛ PLUS BROAD APPLICATION EXPERIENCE means the *right* starter for *your* job! Allis-Chalmers engineering experience covers every major industry.

REMEMBER, ALLIS-CHALMERS OFFERS BOTH Full and Reduced Voltage Starters for *squirrel cage* and *synchronous motors* as well as control for *wound rotor motors*. Depend on this wide range of starters, backed by industry-wide application engineering experience, for the answer to *your* control needs! Ask for bulletin 14B7132.

Texrope and *Vari-Pitch* are Allis-Chalmers trade marks.

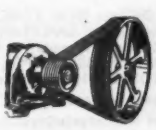
ALLIS-CHALMERS, 930A SO. 70 ST.
MILWAUKEE, WIS.

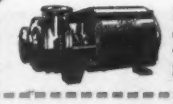
Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.





PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

ALLIS-CHALMERS

33. OUTLET BOXES: Each switch, light, wall receptacle, clock and other miscellaneous device for flush mounting shall be provided with an approved type of outlet box, iron or steel, sherardized or galvanized to prevent rusting.

All outlets in plastered wallsand ceilings shall be equipped with covers to bring same flush with plaster finish. Outlet boxes and covers shall be Appleton or approved equal.

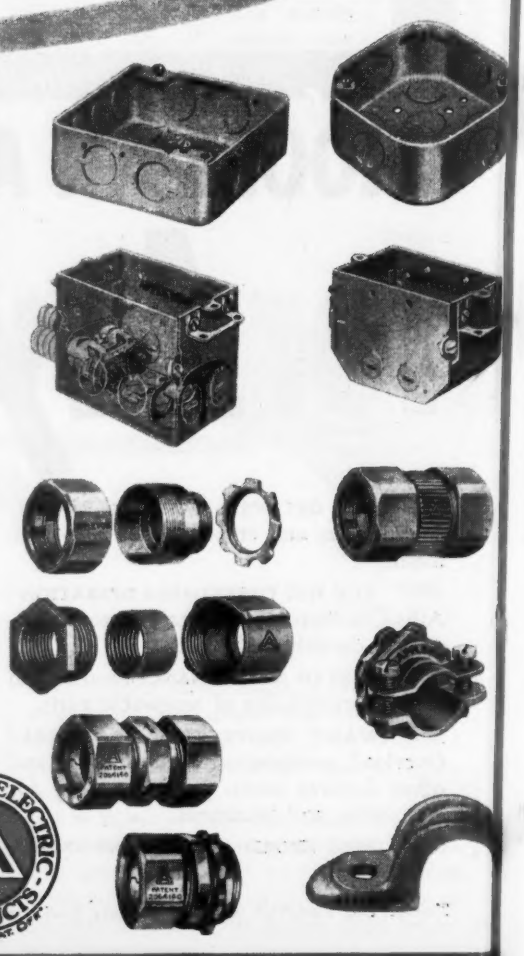
APPLETON in the specifications MEANS PERMANENCE in the building!

One RELIABLE Source for EVERY Electrical Wiring Requirement

The above specifications are from a recent bank building job—a job that called for lasting dependability, first quality throughout. Appleton fittings were specified because they're precision engineered to meet requirements—made to highest standards in Appleton's own foundries and fabricating plants.

Whether it's a simple installation or an intricate system of wiring for a highly hazardous location, you'll find the exact fittings required in the 15,000-item Appleton Line.

Skilfully designed for fast and easy installation, Appleton fittings provide top performance in any type of electrical construction or maintenance. For faster completion of better jobs, specify Appleton, STANDARD FOR BETTER WIRING.



Sold Through Electrical Wholesalers

APPLETON ELECTRIC COMPANY

1704 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

Branch Offices: NEW YORK, 50 Church St. • DETROIT, 3049 E. Grand Blvd. • CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna St. • ST. LOUIS, 420 Frisco Bldg. • LOS ANGELES, 100 N. Santa Fe Avenue • ATLANTA, 724 Boulevard, N.E. • BIRMINGHAM, 429 Brown-Marx Bldg. • MINNEAPOLIS, 305 Fifth St., S. • PITTSBURGH, 414 Bessemer Bldg. • BALTIMORE, 100 East Pleasant St. • BOSTON, 10 High Street • DENVER, 1921 Blake Street • PHILADELPHIA, 1017 Cherry Street.

Resident Representatives: Cincinnati, Dallas, Houston, Indianapolis, Kansas City, Milwaukee, Seattle

Export Representatives: International Standard Electric Corp., 67 Broad St., New York 4, N. Y.

APPLETON ELECTRIC • PRODUCTS • REG. U.S. PAT. OFF.

A P P L E T O N

CONDUIT FITTINGS • LIGHTING EQUIPMENT • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REE

ELECTRICAL CONSTRUCTION AND MAINTENANCE

With which is consolidated Electrical Contracting, The Electrologist and Electrical Record . . . Established 1901

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering installations, repairing, maintenance and management, in the field of electrical construction and maintenance.

July • 1949

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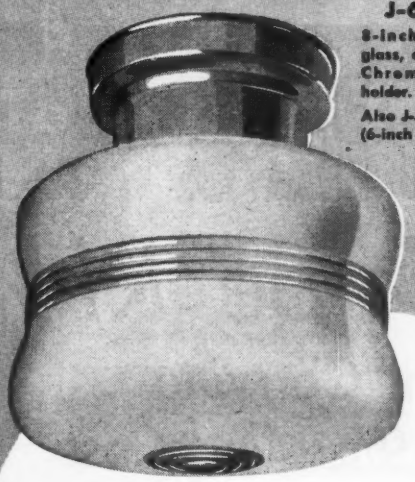


J-60/308
8-inch Enameled glass, crystal bands. Chromium finish holder.
Also J-53/306 (6-inch glass)

V-1508
Chromium ceiling holder Enameled glass with sparkling crystal bottom.
Similar units V-1506 (6-inch) and V-1510 (10-inch).

Practical Units for Kitchen or Bath...

by Virden

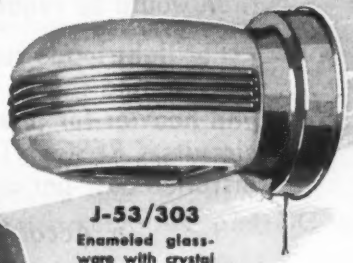
Engineered for good lighting, these modern enclosing units by Virden are pleasingly practical. They combine simple lines with decorative crystal accents . . . fit a wide variety of needs in the home. They offer an attractive choice in shallow or deep ceiling units . . . and in downlighting wall units for use over mirror, sink or counter. Best of all, they're outstanding values . . . thanks to Virden "know-how" in mass production.

Flash! Ask your Virden wholesaler for a copy of the new "Bargain Book"

VIRDEN VALUE

For extra value . . . ask for the box with the big green "V".

J-60/208
Crystal bottom enameled glassware. Chromium holder.
Also J53/206 (6-inch glass)



J-53/303
Enameled glassware with crystal bands and bottom.
Also J-53/CO/303 same with outlet

V-53/153
Diffusing enameled glass with crystal bottom.
Also V-53/CO/153 same unit with outlet.

John C. Virden Company • Cleveland, Ohio

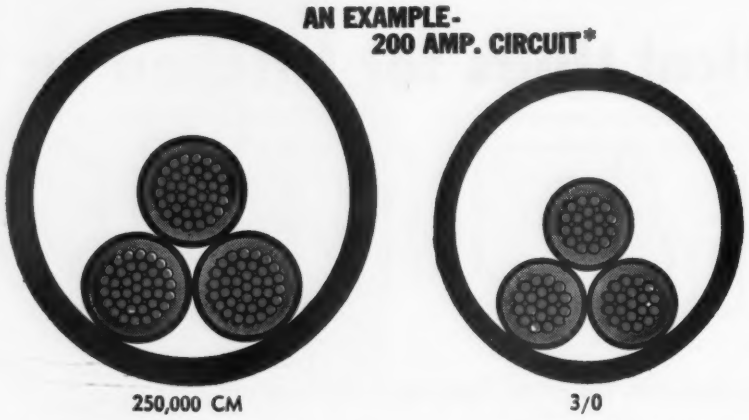
Member American Home Lighting Institute

CRESCENT

ENDURITE Type RH

Gives Greater Current Carrying Capacity per Dollar of Installed Cost

AN EXAMPLE-
200 AMP. CIRCUIT*



250,000 CM

TYPE R

Requires 2½" Conduit. Maximum permissible operating temperature 60°C.

3/0

TYPE RH

Requires 2" Conduit. Maximum permissible operating temperature 75°C.

The superior heat resistant characteristics of CRESCENT ENDURITE INSULATION with its higher permissible operating temperature and therefore greater current carrying capacity, permit the use of a smaller size of conductor, and in most cases smaller size of conduit at less cost than would be required for Type R Wire for the same load.

For light loads requiring small sized conductors, Voltage Drop is the determining factor in choice of wire size. Usually in sizes No. 6 AWG and heavier for power circuits or No. 1 AWG and heavier for lighting circuits, CRESCENT ENDURITE Type RH Wire & Cable gives the lowest installed cost-per-ampere of useful circuit capacity.

**In Accordance with 1947 National Electrical Code.*

CRESCENT

WIRE and CABLE

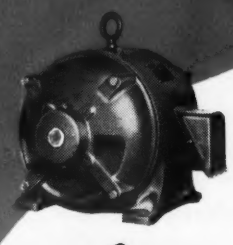
OVER 60 YEARS EXPERIENCE

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, NEW JERSEY

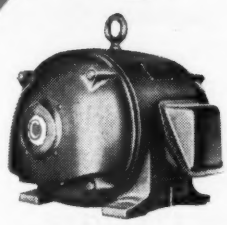
There's a Century MOTOR To Supply Dependable Power For All Popular Applications

Century motors are available in sizes from 1/6 to 400 horsepower, in a wide range of types and kinds — single phase and polyphase alternating current, and direct current. All of them are ruggedly built to assure top performance throughout a long service life.

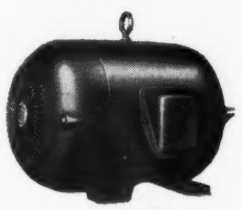
POLYPHASE



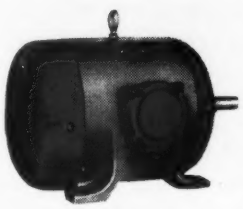
Type SC—OPEN PROTECTED—Form J, general purpose motor—meets the needs for most installations where operating conditions are relatively clean and dry. The top half of the motor frame is closed to keep out falling solids or dripping liquid.



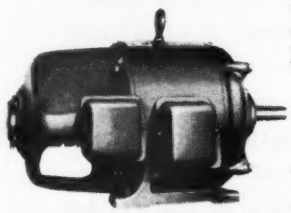
Type SC—SPLASH PROOF—gives the necessary protection where plants must be washed down—keeps water out of the motor even when a hose is applied directly on the frame. Also provides protection against rain, snow, sleet and ice for outdoor installations.



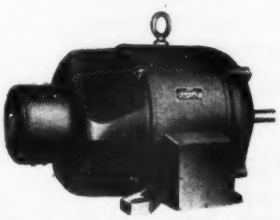
Type SC—TOTALLY ENCLOSED FAN COOLED—protects against dusts, mist or fog detrimental to the vital parts of the motor. The inner frame protecting the motor is sealed to keep out harmful matter.



Type SC—EXPLOSION PROOF protects against atmospheres charged with explosive dusts or gases. They carry Underwriters' label for specific kinds of hazards.

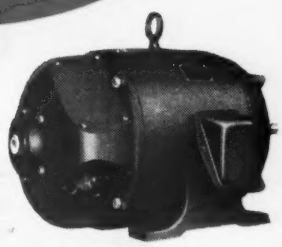


Type SR—SLIP RING- wound rotor motors are suitable for applications requiring low starting current with high starting torque, reversing, or adjustable speed.

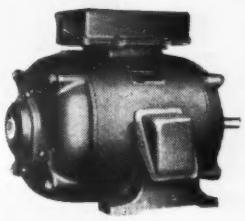


Type SY—SYNCHRONOUS MOTORS- suitable for continuous operation at a uniform load for power factor correction.

SINGLE PHASE



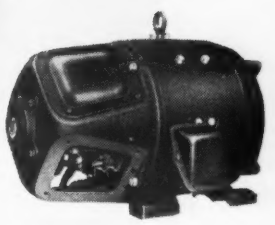
Type RS—REPULSION START INDUCTION—single phase brush lifting motor suitable for applications requiring high starting torque with low starting current.



Type CSH—CAPACITOR START INDUCTION—single phase motor suitable when high starting torque with normal starting current is required.

Type SP—SPLIT PHASE, INDUCTION—single phase motors—suitable for light starting duty.

DIRECT CURRENT



Type DN—DIRECT CURRENT MOTORS—suitable for use where direct current is available or its use desirable.

These illustrations are typical of Century's complete line of motors. Others available include gear motors, generators, AC and DC motor generator sets.

Specify the right Century motor for all your electric power requirements.

Popular types of standard ratings are generally available from factory and branch office stocks.

CENTURY ELECTRIC COMPANY

1806 Pine Street
St. Louis 3, Missouri

Century C MOTORS

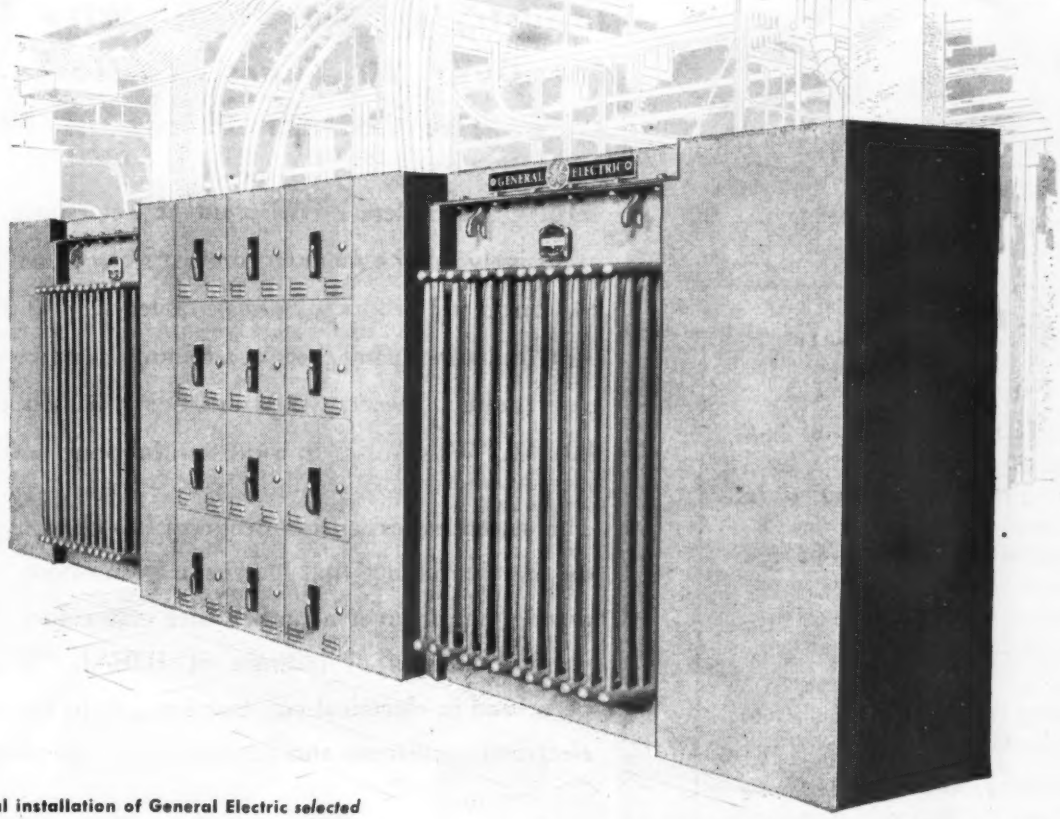
645

Offices and Stock Points in Principal Cities

substations give you...

Improved appearance at no extra cost!

Note the smooth, integrated appearance of these new General Electric Pyranol* unit substations . . . no more gawky, "old-type" stovepipe connections between transformer and switchgear . . . now you can get the effortless flow of line and power that characterizes quality equipment for locations where appearance is a requisite. All these features at the same price as previous units.



Industrial installation of General Electric *selected standard* double-ended load-center unit substation rated 1500 kva, 4160 volts, 208Y/120 volts. Unit has oil cutout in incoming line sections, Pyranol-filled transformers, and the new AK-1 drawout air circuit breakers.

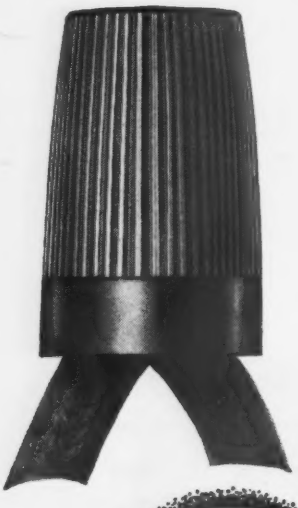
*Reg. U.S. Pat. Off.

★ *Be sure to see the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.*

GENERAL ELECTRIC

321-60

PRICES REDUCED UP TO 32%



on IDEAL Wire-Nuts*

Patented, No. 1,933,555

THE SOLDERLESS, TAPELESS WIRE CONNECTOR

Industry's "Standard" Wire Connector for Over 20 Years . . . Now Available at the Lowest Prices in History!

IDEAL'S complete NEW plant at Petersburg, Illinois, built exclusively for the manufacture of "Wire-Nuts", with continuous automatic production, has enabled IDEAL to slash "Wire-Nut" manufacturing costs to a minimum. In keeping with company policy, these savings are being passed on to users of IDEAL "Wire-Nuts" in a substantial price reduction.

This extensive expansion program has been made possible by the user preference that has made "Wire-Nuts" first choice by a wide margin over all other wire connectors. In the past 20 years, hundreds of millions of IDEAL "Wire-Nuts" have been used in electrical construction . . . in the manufacture of electrical appliances and equipment . . . in plant and building maintenance.

*Trade Mark Reg. U.S. Pat. Off.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR THE NEW LOWER PRICES THAT MEAN *EXTRA* SAVINGS TO YOU

NO REDUCTION IN QUALITY

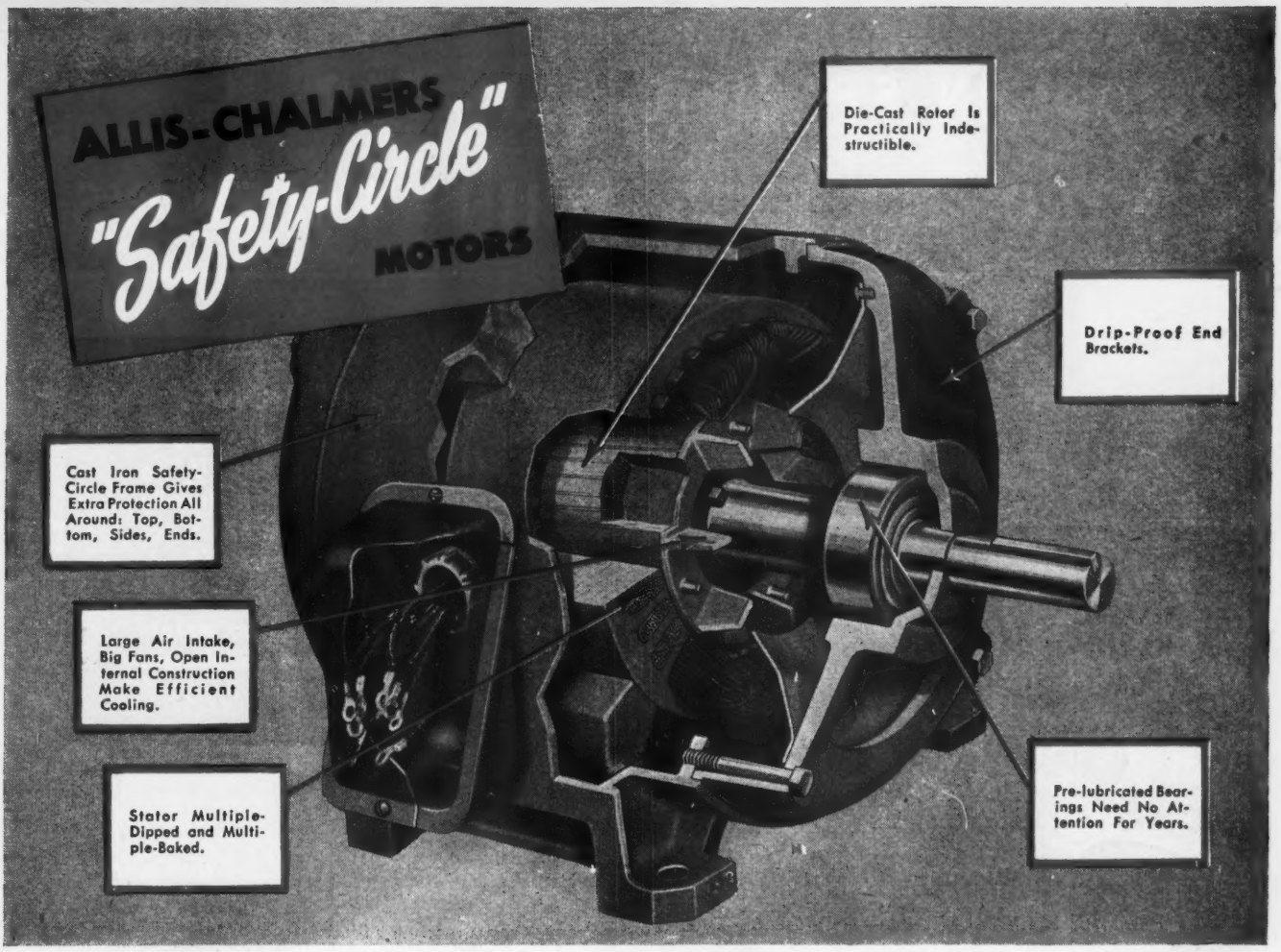
Today—you get a better wire connector at less cost. The Ideal "Wire-Nut"—consisting of a copper-coated coil spring insert imbedded in a molded plastic shell—is made to the highest precision standards.

Factory-Tested—All materials are thoroughly tested . . . spring inserts and shells are accurately checked.

Factory-Inspected — Every finished "Wire-Nut" is visually inspected before being packaged.

IDEAL

IDEAL INDUSTRIES, Inc. Sycamore, Illinois



HOW SAFETY-CIRCLE

Means Motor Dependability

EXTRA PROTECTION means extra dependability. That's why Allis-Chalmers protects the working parts of the motor with the exclusive SAFETY-CIRCLE. Compare this motor with motors of less rigid construction. The SAFETY-CIRCLE motor will not distort in mounting or under strain. And you get the extra protection of drip-proof end brackets at no premium.

EXTRA PROTECTION INSIDE, TOO

Stator is multiple-dipped and multiple-baked in special insulating varnish. Rotor is die-cast aluminum. Stator is mounted in four longitudinal ribs which leaves plenty of air space between stator and frame. Large fans cast integrally with the rotor and ample air intakes keep temperatures well within rated limits. *Ball bearings are factory-lubricated and require no further attention for years.*

When you shop for motors, remember SAFETY-CIRCLE gives you *extra protection, extra dependability* and *lower operating costs.*

For details on SAFETY-CIRCLE advantages, see your A-C Authorized Dealer or Sales Office or write for Bulletin 51B6210B. Sizes 1 to 20 hp, 326 frames and smaller. *Safety-Circle, Texrope* and *Vari-Pitch* are Allis-Chalmers trademarks.

ALLIS-CHALMERS, 930A SO. 70 ST. A-2691
MILWAUKEE, WIS.

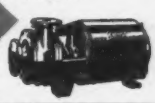
ALLIS-CHALMERS

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.



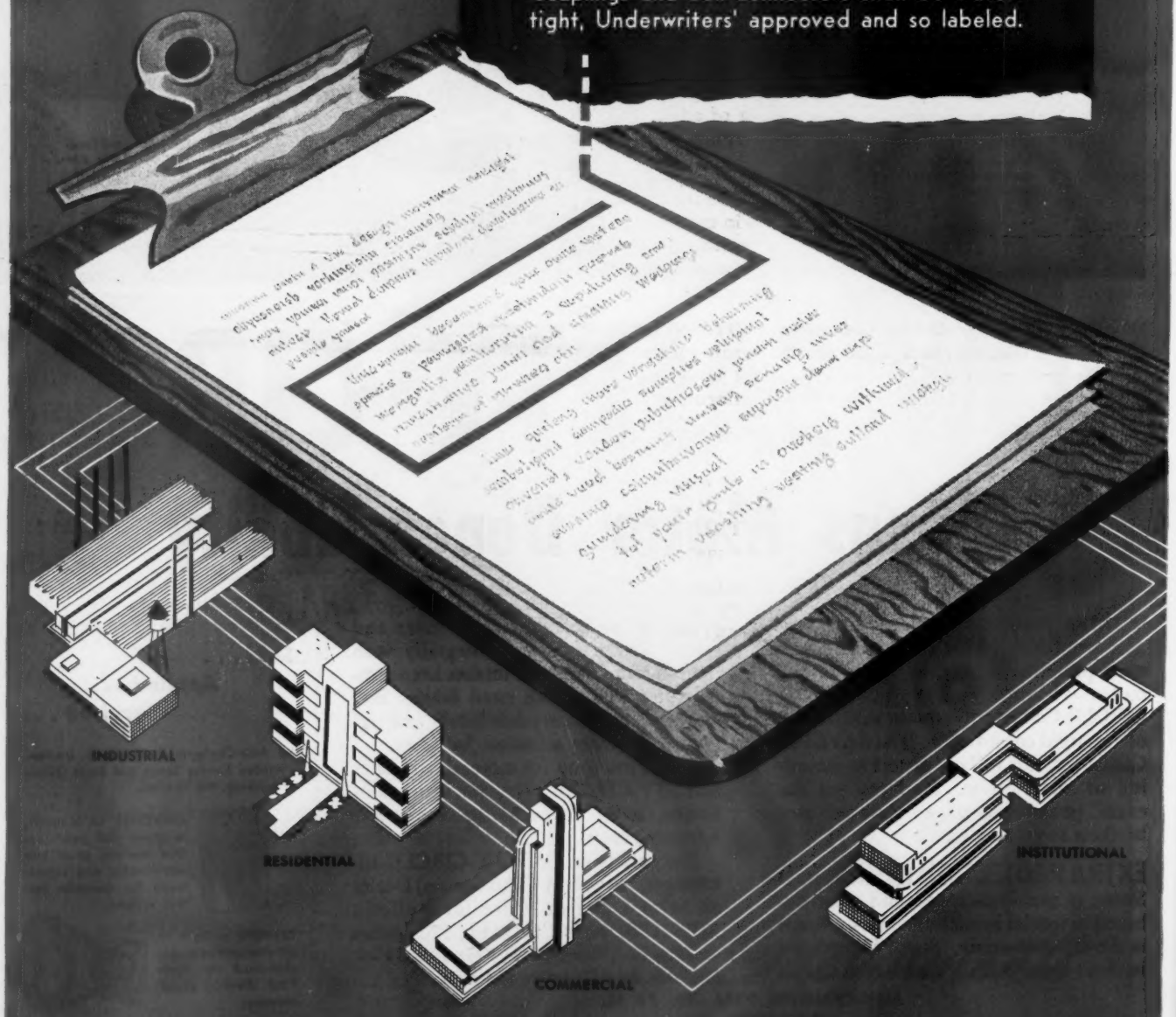
PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

MODERN SPECIFICATION FOR TROUBLE-FREE WIRING RACEWAYS...

RACEWAY SPECIFICATIONS

All electrical conductors shall be enclosed in ELECTRUNITE E.M.T., or equal, in sizes ½" to 2", inclusive. Tubing shall be steel, electrically welded, galvanized and manufactured in accordance with Underwriters' Laboratories Standards, and so indicated.

Couplings and box connectors shall be watertight, Underwriters' approved and so labeled.



ELECTRUNITE E. M. T. is the ORIGINAL

ELECTRUNITE E.M.T.

Electrical Metallic Tubing

Time-proved in every type of installation—commercial . . . industrial . . . institutional . . . residential—Republic ELECTRUNITE E.M.T. gives a combination of advantages unequalled by any other rigid steel raceway material.

This modern raceway is made from tough, strong, abuse-resistant steel. It protects life and property . . . furnishing a grounded system. It requires less room in concrete slabs and partitions. And because it is *threadless,* its tightly-adherent zinc coating provides continuous rust- and corrosion-resistance throughout the installation.

These are but a few of the reasons why ELECTRUNITE E.M.T. meets Underwriters' Laboratories requirements, and is approved by the National Electrical Code for exposed, concealed and concrete slab construction.

In addition, ELECTRUNITE E.M.T.'s many installation advantages—light weight . . . Inch-Marking . . . knurled inside surface . . . ease of bending—make it a heavy favorite with contractors and workmen alike. Designed solely for electrical raceway use, ELECTRUNITE E.M.T. truly is the electrician's raceway material.

On every job, insist that electrical specifications include genuine Republic ELECTRUNITE E.M.T. For further information, see your ELECTRUNITE Distributor, or write to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

With modern ELECTRUNITE E.M.T., all types of bends, stubs and offsets can be made readily and easily—on the job—with predetermined accuracy. Water-tight compression fittings eliminate thread-cutting . . . make strong, vibration-proof joints.

REPUBLIC STEEL

Republic
ELECTRUNITE E.M.T.

Lightweight Threadless Rigid Steel Wiring Raceway

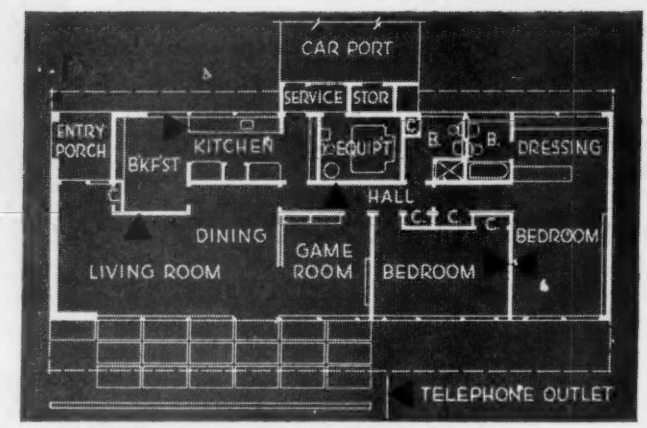
Samuel G. Wiener and William B. Wiener, Architects

GETTING DOWN TO DETAILS—TELEPHONE RACEWAYS ARE IMPORTANT

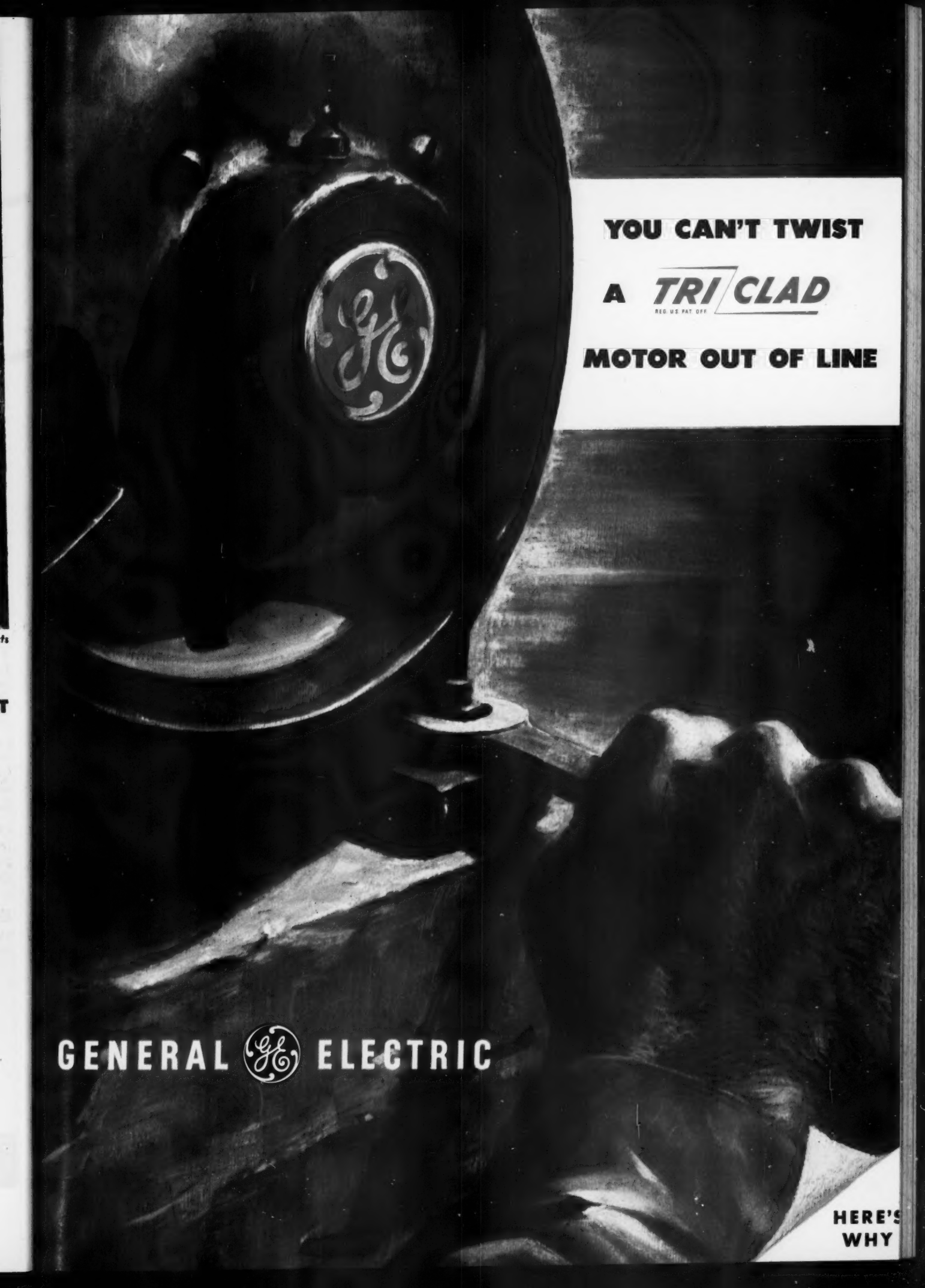
The smaller a house is, the more it makes little refinements stand out. Well up on the list with today's homeowners are the neatness and convenience of built-in telephone facilities.

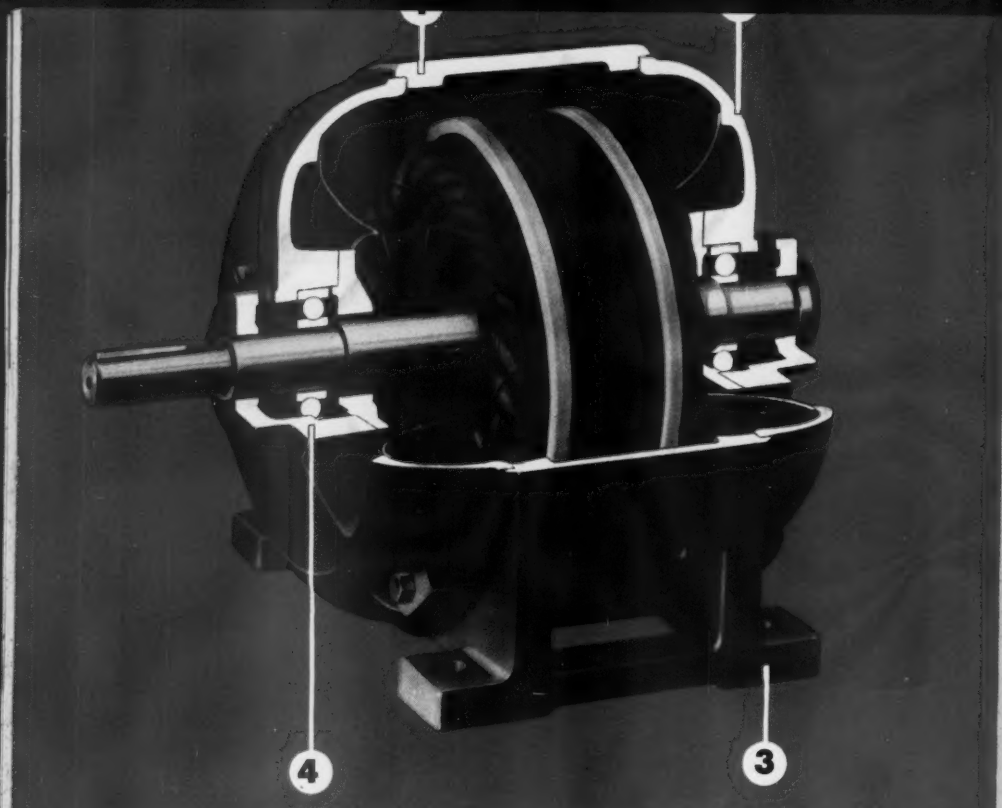
Built-in raceways eliminate exposed telephone wires on walls and woodwork. And they mean extra profits for you.

Remember—NO ELECTRICAL CONTRACT IS REALLY COMPLETE UNLESS IT INCLUDES RACEWAYS FOR TELEPHONE WIRES.



BELL TELEPHONE SYSTEM


YOU CAN'T TWIST
A TRI CLAD
REG. U.S. PAT. OFF.
MOTOR OUT OF LINE
GENERAL ELECTRIC
HERE'S
WHY



Look at the solidity of a Tri-Clad's thick-section cast-iron frame (1) and heavily reinforced end shields (2) . . . its heavy integrally cast feet (3). Do you wonder we say "Tri-Clad gives you structural strength and rigidity no other general purpose motor can match"? Notice, too, the *completely enclosed* bearings (4). A Tri-Clad motor will run safely without relubrication for years — as long as any general-purpose motor you can buy. Yet it's grease-gun easy to lubricate if you ever need to.

You can't twist a TRI/CLAD motor out of line

Try as a heavy-muscled mechanic may, he can't twist a Tri-Clad motor frame when bolting it to an uneven surface. The bolt will snap before he can pull that rigid cast-iron structure out of line.

Important? It's one of the basic reasons General Electric believes cast iron to be the ideal structure for general-purpose industrial motors. Other reasons? Cast iron has unusually high resistance to rust and corrosion. It has an inherent damping action that minimizes resonance. And . . . it won't take on an injurious permanent "set" as a result of accidental blows or mechanical abuse.

Want a motor that's been **SERVICE-PROVED** in 5 billion hours of rugged industrial use? Nearly all types and ratings are **AVAILABLE FROM STOCK.**

Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

TRI/CLAD
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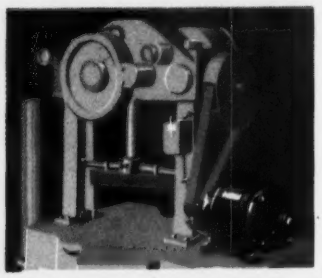
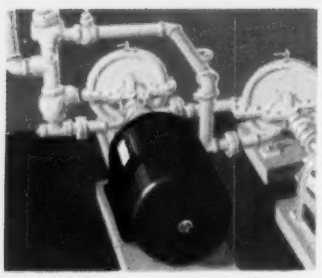
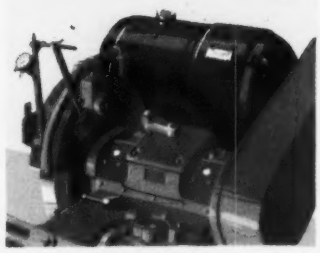
EXTRA PROTECTION



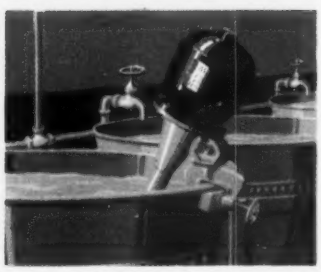
G-E open (dripproof) induction motors for constant-load, constant-speed applications. From 1 to 2000 hp.



G-E totally enclosed motors for outdoor operation, in abrasive dusts, or corrosive fumes. From 1 to 1000 hp.

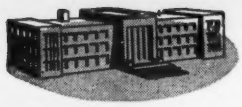


G-E Type ACA induction motors for adjustable speeds—provide 3 to 1 speed range. From 3 to 75 hp.

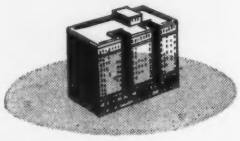


G-E flange and face-type motors for use where the machine supports the motor, or vice versa. From 1/20 to 60 hp.

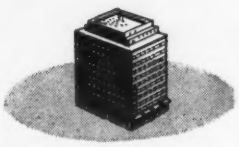
Look for this **EXTRA** on the motor you buy!



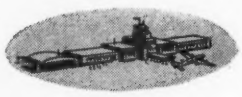
SCHOOLS . . .
A centralized sound system for announcements and bulletins, distribution of radio programs, educational recordings . . . to any or all rooms of a school.



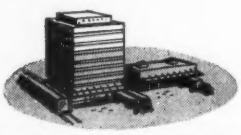
HOTELS . . .
Voice-paging, entertainment in guest rooms and dining rooms, emergency announcing facilities.



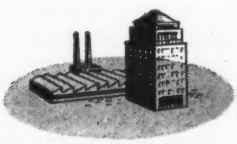
DEPARTMENT STORES . . .
Music broadcasts, merchandise announcements, administrative control.



AIRPORTS and TERMINALS . . .
Voice-paging, announce system, entertainment, dispatching.



WAREHOUSES and GARAGES . . .
Traffic control, dispatching, voice-paging.



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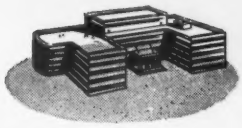

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Voice-paging, emergency announcements, convalescent entertainment, musical therapy.

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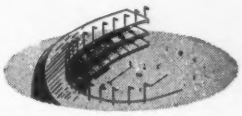
Complete sound distribution to all parts of the auditorium.



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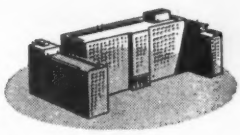

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Voice-paging, administrative control, entertainment, emergency control.

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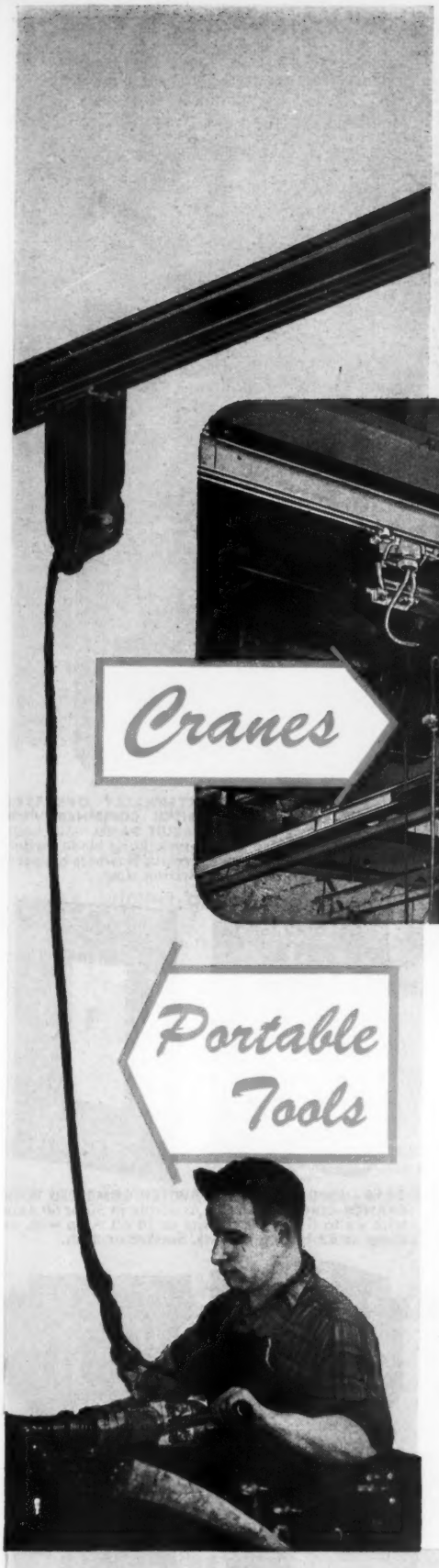

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WITH FEEDRAIL *in* ELECTRICAL TROUBLES *are out!*

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Shut-downs due to faulty wiring and connectors disappear when the totally enclosed Electric Feedrail Distribution System is installed. You don't have to wait even for rewiring when you relocate electrical equipment in your plant.

Hand tools on the production line are connected to the Feedrail trolley in a jiffy and the problem of moving test lines, bench-work, and moveable lights, is solved for all time.

Feedrail is approved by the Underwriters' Laboratories Inc., and endorsed by leading mechanical, electrical and industrial engineers. Can be installed by your electrician or contractor in a few days.

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24

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FEEDRAIL CORPORATION

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WHEN ESTIMATING LOW-COST HOUSING...THE SWITCH IS TO GENERAL

Title 608 Project: Courtesy James G. Ludwig, R. A., Architect, West Chester and Upper Darby, Pa.

Architects, builders and electrical contractors are switching to GENERAL SWITCH equipment because it is:

Available everywhere through leading wholesalers—No lost labor time waiting for GENERAL equipment to reach the job.

Economical to install—Takes less time to install because of compact open construction, integral internal conductors and spacious wiring room.

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HERE are three units of GENERAL equipment which have been "application engineered" for and are particularly well suited to low-cost housing construction:

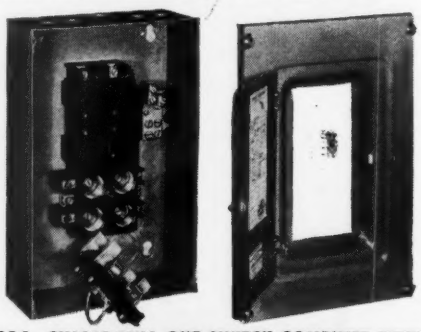
GENERAL SWITCH 33NP4—Ideal selection where an externally operated switch is required in combination with a residence panel at the point of service entrance. Has the advantage of dead front branch circuit fuses yet the entire unit is readily accessible with spacious wiring room. Also available in raintight construction.

GENERAL SWITCH 3614—Where a pull-out switch may be used, this equipment offers economy, versatility and compactness. Available for flush or surface mounting. Has sub-feed pressure connectors which may be used as main lugs, leaving the pull-out switch available for range, water heater or other circuit.

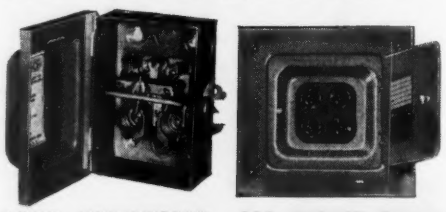
GENERAL SWITCH 33NP and 104—When it is desirable to have the branch circuit fuse panel conveniently located remotely from the switch, this service entrance switch and plug fuse panel has wide acceptance. Residence panel available for flush or surface mounting.

For availability, economical installation and trouble-free performance *the switch is to* GENERAL. Available everywhere exclusively through Wholesalers.

33NP4—EXTERNALLY OPERATED SAFETY SWITCH COMBINED WITH BRANCH-CIRCUIT PANEL—30 Amp, 3 wire, 2 plug fuse quick-break knife blade switch with four plug fuse branch circuits. Bus-bars between switch and fuse block save wiring time.



3614—SINGLE PULL OUT SWITCH COMBINED WITH BRANCH-CIRCUIT PANEL—Available in 30 or 60 Amp with up to 6 branch circuits or in 60 Amp with as many as 12 branch circuits. Surface or flush.



33NP—EXTERNALLY OPERATED SAFETY SWITCH—3 wire, 2 plug fuse quick-break knife blade switch for use as service entrance equipment.

104—BRANCH-CIRCUIT or RESIDENCE PANEL—Available up to 32 plug fuse circuits. Flush spring catch. Surface or flush.

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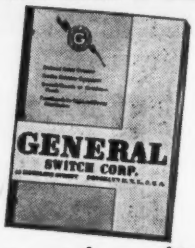
Ask your wholesaler or write today for the GENERAL SWITCH 68-page catalog



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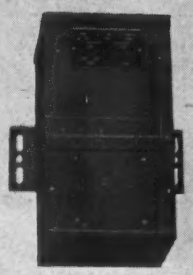

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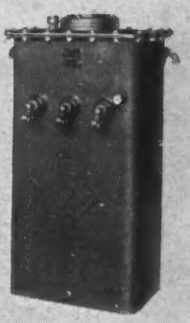
Veteran transformers, on the job many years and still delivering full performance, are one testimony of STANDARD'S engineering soundness and craftsmen construction. STANDARD'S leadership in contributing improvements to transformer design and building is another. Yet another qualification for your consideration, is STANDARD'S extensive experience in designing and building for special needs. Whether your transformer need is for a low voltage midget or a high voltage giant, STANDARD can best serve your need.



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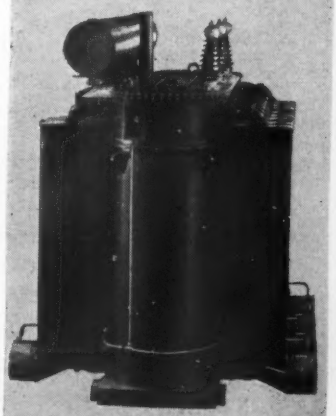

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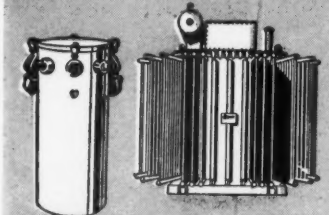
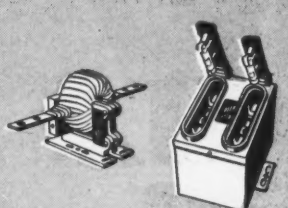
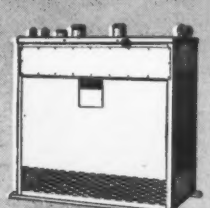


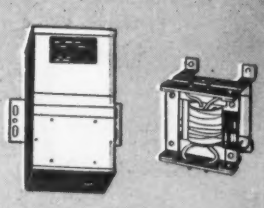
Liquid filled (sizes up to 10,000 KVA and 72 KV inc.)



Instrument transformers (for use on circuits up to 72,000 volts, inc.)



Dry type (up to 1000 KVA and max. voltage ratings of 4800)



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The ever-broadening popularity of LEADER FLUORESCENT FIXTURES is due to a combination of sound, durable construction, advanced styling, and big-value pricing. . . . For full particulars on LEADER Fixtures, here illustrated, and for the many others in the LEADER line, write to

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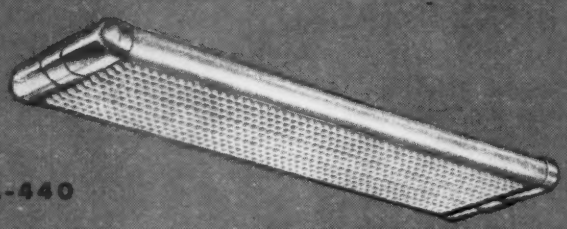
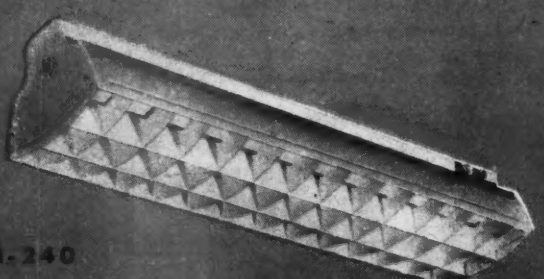


VL-440

Leader's "OFFICER" fixture for four 40-watt T-12 48" lamps, may be used in single units or in continuous runs . . . ceiling mounted or suspended. Translucent plastic side panels and plastic louvers (swing out of the way for easy servicing). Choice of 31° or 45° cut-off angle in louvers. Housing, channel and end caps of 20 gauge steel, finished in white high-gloss baked enamel. Optional instant-start operation. 53⅜" x 16¼" x 5-17/32".

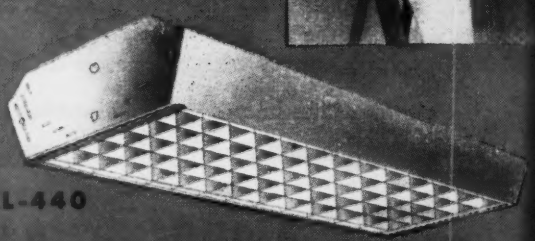


SM-240

Leader's "SCHOOLMASTER" provides 60% downward, 40% upward light distribution. Standard louver cut-offs of 25°-35° and 25°-45° (other shielding angles on request). Uses two 40-watt T-12 48" lamps. Housing and channel of 20 gauge steel, finished in white high-gloss baked enamel. Optional instant-start operation. 48-3/32" x 12⅜" x 8-3/16".

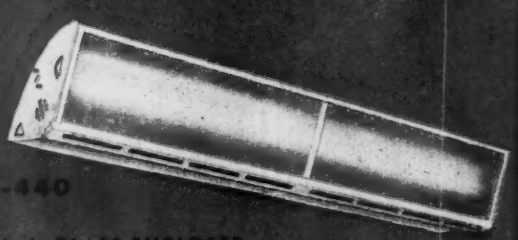
LEADERALL . . .

Illumination over all—from wall to wall. Featherweight moulded plastic units, held by adjustable tie rods, give absolutely level and rigid ceiling of light, "dropped" to any desired height. Use with any type fluorescent lamp. Does not interfere with sprinkler systems. Instantly removable for servicing. Individual units 13" x 48"—four units to a basic frame, 48-1/16" x 52¼". Other sizes custom made.



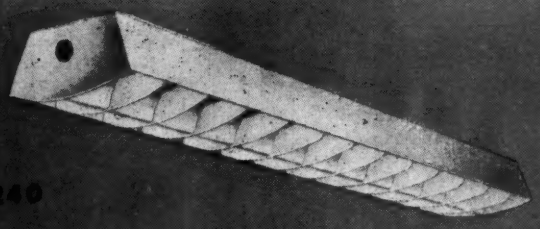
LRL-440

Leader's "RESEARCH LUMINAIRE" conforms to technical specifications of the Utilities Research Commission. For four 40-watt T-12 48" lamps. Use as single units or in continuous runs—suspended or ceiling mounted. No connecting couplers needed for continuous row installa... Housing and channel of 20 ga... steel, finished in silver-gray ...amel. Interior finished in w... high-gloss baked enamel. ...tional instant-start opera... 49-9/32" x 19⅝" x 7".



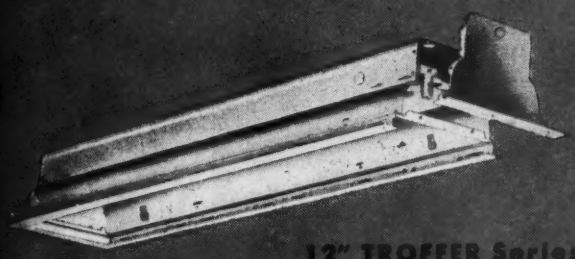
GL-440

Leader's GLASS ENCLOSED LOUVERED fixture uses four 40-watt T-12 48" lamps, affords large output of diffused light. Hinged glass panels for easy servicing. Use as single units or in continuous rows. No connecting couplers needed for row in... stallation. Housing and cha... of 20 gauge steel in satin al... num finish. Parabolic refl... finished in white high-... baked enamel. Optional in... start operation. 48-7/16" x 13... x 7¾".



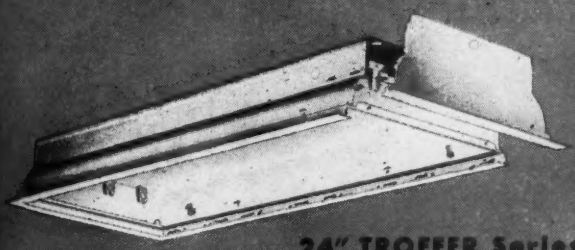
V-240

Leader's "VARSITY" performs like a luxury-type model, yet fits into limited budgets. Uses two 40-watt lamps. Use as single units or in continuous runs. No connecting couplers needed for continuous row mounting. Baffle-type louvers offer shielding angles of 25°-35°, are easily removable for maintenance purposes. Housing and channel of 20 gauge steel. Overall finish is of white baked enamel. 48" x 13" x 6¼".



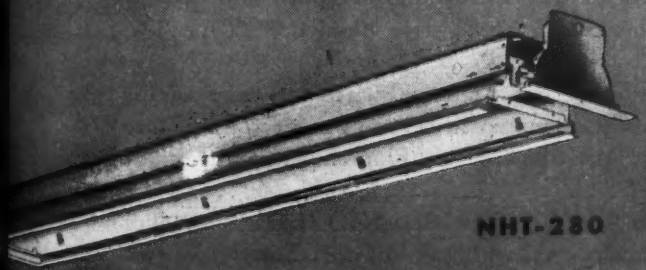
12" TROFFER Series

Leader Trofferlites furnish versatile, efficient fluorescent lighting. Available with flange trim or T-bar mounting. For use as single units or in continuous rows. 12" Troffers use two or three 40-watt 48" lamps. Choice of styles: open, louvered, baffled, or glass enclosed. Housing and channel of 20 gauge steel, finished in aluminum-gray baked enamel. Interior finished in white high-gloss baked enamel. Optional instant-start operation. 48"x12" (13-11/16" with flange) x 7⅜".



24" TROFFER Series

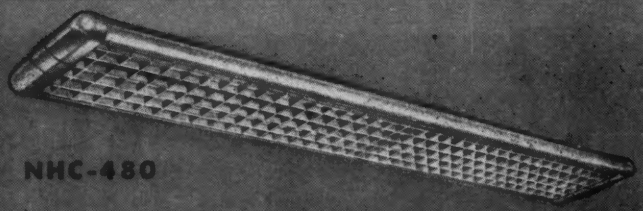
Same specifications as for 12" Trofferlites, but 24" width offers a fine variety of lighting applications. Available with or without Alzak liners. Also can be furnished with Holophane Controlens. 48" x 24" (25-11/16" with flange) x 7⅜".



NHT-280

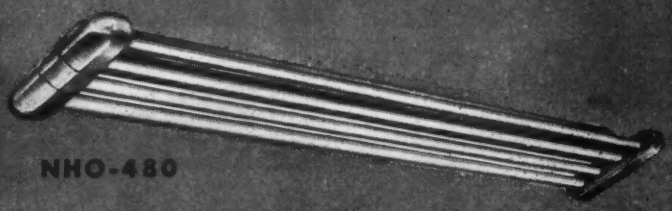
Slimline TROFFER fixtures offer better redirection of light flux and higher light values. For one (NHT-180), two (NHT-280) or three (NHT-380) slimline tubes. Furnished with or without flange trim, baffled, louvered or glass enclosed. Housing and channel of 20 gauge steel, finished in silver-gray enamel. Interior finished in white high-gloss baked enamel. Instant-start 100, 200, 300 or 425 milliampere operation. 72" (or 96") x 12" (13-11/16" with flange) x 7⅜".

All Leader slimline fixtures available for use with new 75 watt T-12 lamps at 425 milliamperes.



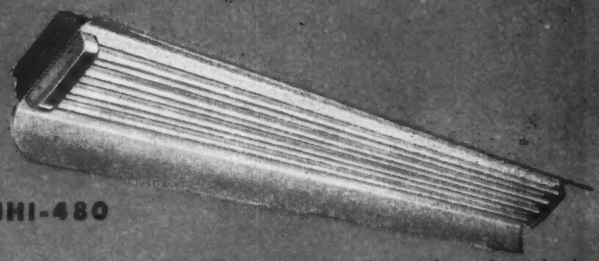
NHC-480

Leader's "NEW HORIZON" fixture for four T-8 96" slimline lamps, is characterized by graceful thinness of depth. Translucent plastic side panels and plastic louvers (swing down to left and right for servicing). Housing, channel and end caps of deep drawn steel, finished in white, high-gloss baked enamel. Instant-start 100, 200, 300 or 425 milliampere operation. 101¼" x 16¼" x 5-17/32".



NHO-480

Leader's OPEN TYPE fixture for four 96" slimline lamps, offers many advantages in efficiency and low maintenance cost. (Other tube lengths available on request.) Embossing provides exceptionally rigid channel and closer ceiling mounting. Housing and channel of 20 gauge steel, finished in white high-gloss baked enamel. Pleasing deep drawn, streamlined end caps. Instant-start 100, 200, 300 or 425 milliampere operation. 97-5/16" x 16-1/16" x 5-17/32".

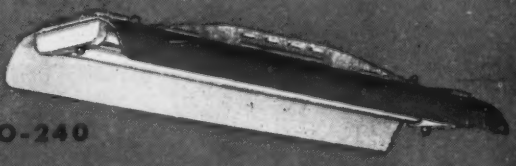


NHI-480

Leader's "NEW HORIZON" INDUSTRIAL fixture combines high light intensity with streamlined styling. Uses four 96" slimline tubes. Constructed for continuous run wireway installations. Grooved channel for adjustable sliding clamp hangers. Reflectors and one-piece channel of 20 gauge steel. Channel and top reflector surface finished in gray baked enamel, interior in white high-gloss baked enamel or in porcelain. Instant-start 100, 200, 300 or 425 milliampere operation. 96-1/16" x 13¼" x 6½".

IUO-240

Leader's "STRATOLINER" open type fixture for two 40-watt 48" lamps, is an efficient, all-steel, heavy-duty fixture. For use as single units or in continuous rows—ceiling or suspension mounted. Exterior finished in gray baked enamel; reflector in choice of white baked enamel or porcelain enamel. Optional instant-start operation. 51" x 13¼" x 6-7/16".



ZUO-240

Leader's "ZEPHYRLITE" open type fixture, for two 40-watt 48" lamps, is unusually strong and rigid, insuring installations against warping, twisting or sagging. Use as single units or in continuous rows—ceiling or suspension mounting. Housing of 20 gauge steel, finished in gray baked enamel. Reflector finished in choice of double coated white baked enamel or porcelain. Optional instant-start operation. 51"x13½"x 6-3/16".

For rewiring that

Pays today

For rewiring that really pays its way in installation speed and savings on space — you just can't beat General Electric Flamenol® Type TW building wires.

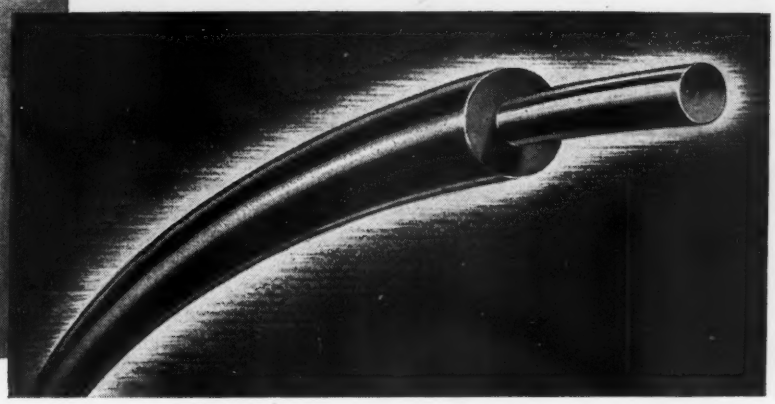
The thermoplastic insulation on G-E Flamenol wires cuts clean, strips off easily. For quick installation, Flamenol wires are wax-coated, to slide easily through raceways. For speed on the job, Flamenol wires are light — easy to handle.

For more current in existing raceways, General Electric Flamenol wires make use of the maximum permissible conduit area. Small-diameter insulation lets you pull through more wires per raceway.

GENERAL ELECTRIC

t pays its way

Flamenol Building Wire



Pays in the years to come

Because this thermoplastic was developed expressly as an electrical insulating material, G-E Flamenol building wires are made to last. Flamenol insulation will keep its smooth surface and maintain its high dielectric strength indefinitely. These wires also resist the effects of air, acids, alkalies, water, grease, and oil—will not support combustion. A variety of colors makes circuit tracing easy.

LOOK TO GENERAL ELECTRIC Flamenol wires for rewiring that really pays its way on the job. For more information, write to Section W29-718, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

...from the complete line of G-E wires and cables—

INDUSTRIAL

Flamenol cable • Flamenol building wire • interlocked-armor cable • Coronol®- and Versatol®-neoprene cables • varnished cambric cable • aerial cable • Deltabeston® asbestos-varnished cambric power cables • portable cable • boiler room wire • portable cord • parkway cable

COMMERCIAL and INSTITUTIONAL

Flamenol building wire • leaded building wire • Portable cord and cable • Deltabeston power cable • remote control system wire • boiler room wire

RESIDENTIAL

PVX® and BraidX® nonmetallic-sheathed cables • BX® armored cable • service entrance cable • remote control system wire

UTILITY

solid paper-insulated cable • gas-filled cable • pipe cable • varnished cambric cable • Coronol- and Versatol-neoprene cables • aerial cable • Flamenol cable • asbestos-varnished cambric cable • boiler room wire

SPECIALIZED INDUSTRIES

mine cable • railway signal wire and line wire • control cable • portable cord and cable • locomotive cable

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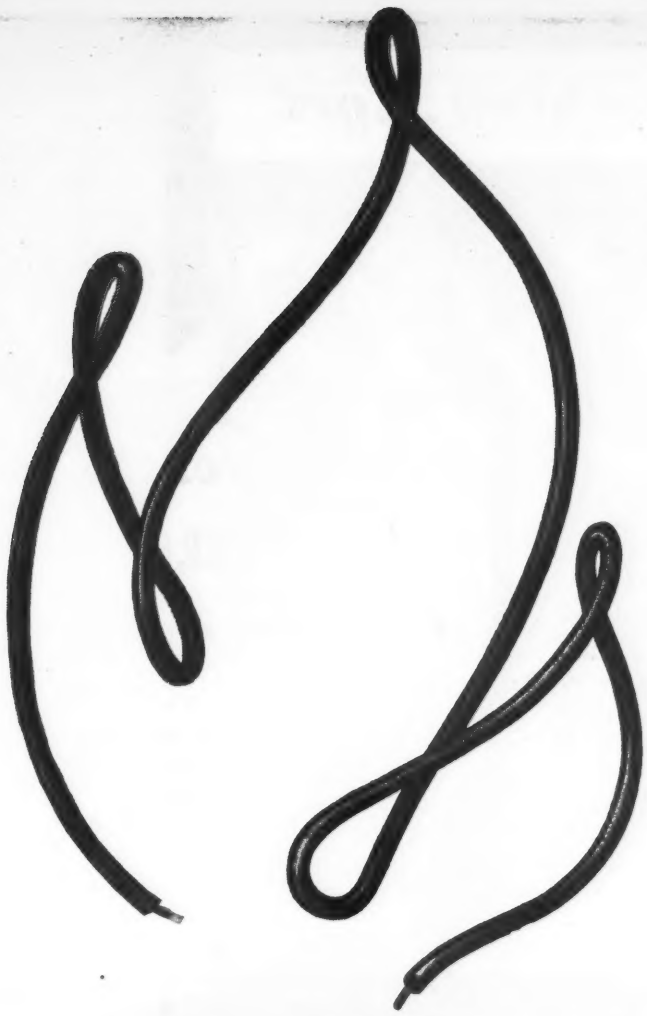

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It is Intelin IN-108 — product of the Selenium-Intelin Division of Federal Telephone and Radio Corporation. Its insulation, developed by Federal, is based on VINYLITE Brand Plastics.

This construction has received Underwriters' Laboratories approval for operation at 90° C.

Economical VINYLITE Brand Plastic insulation materials are bringing many other equally spectacular advantages to wire and cable users. They provide thinner walls, saving space and, of course, weight. All types are highly resistant to abrasion, to most chemicals, to grease, oil, alkalis, moisture and sunlight.

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SPECIFICATION PRACTICE

MOST OF THE EDITORIAL PAGES in this issue are devoted to a Master Electrical Specification. With a break during the war, this feature has been brought up-to-date at three year intervals since 1936. The current project is extensively revised to reflect many important changes of the postwar era.

IT IS OFTEN DIFFICULT for those outside of the electrical industry to understand the importance of specifications as detailed and comprehensive as electrical work requires. It would be just as difficult for them to realize the tremendous scope and complexity of the industry itself in these times.

A SINGLE JOB may include six or more distinct wiring systems, several distribution voltages, a wide variety of incandescent and fluorescent and mercury vapor lighting, three or four fundamentally different methods of electric heating, and an indefinite number of different applications of power control and communication. Furthermore, a single project may include areas from wood frame construction through Class I hazardous locations.

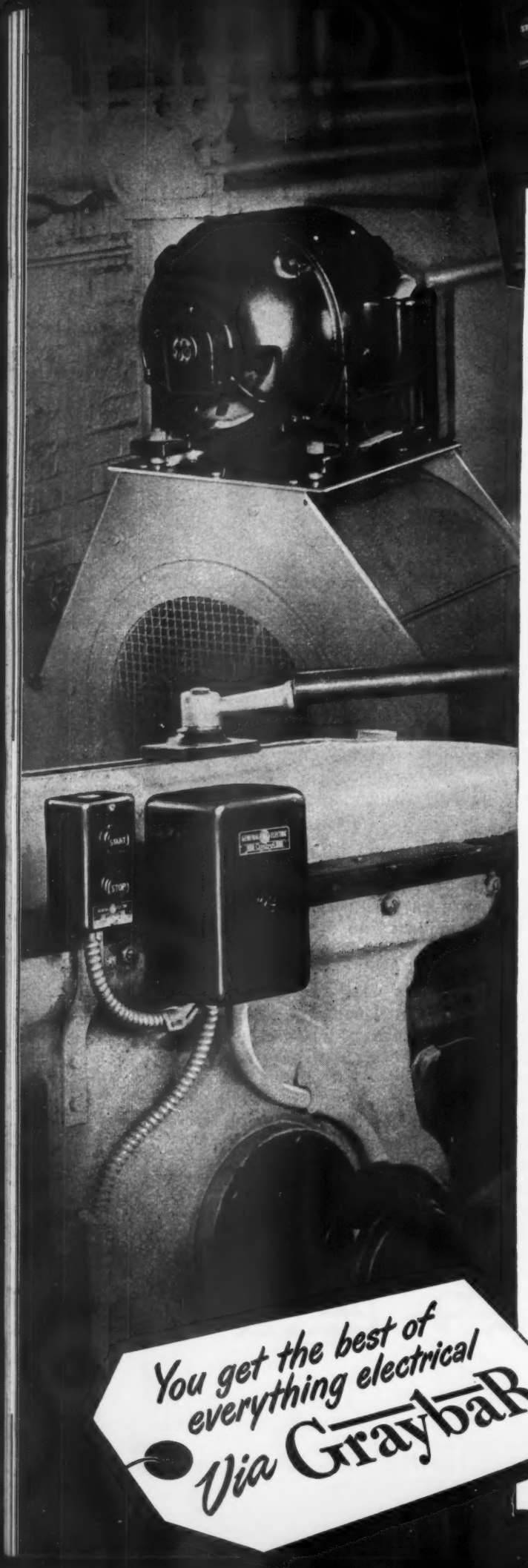
THE AREAS, equipment, methods and materials involved in electrical construction and installation require an almost unlimited number of selections and choices, any one of which can affect the standards and quality of the whole job. Wide open specifications and unlimited price competition will bring almost certain chaos.

GOOD SPECIFICATIONS practice narrows and simplifies the range of choices within acceptable quality limits. They do not freeze technology or block constructive initiative and ingenuity. Iron clad, air tight specifications are an extreme which can also be a serious hindrance to progress in a dynamic industry.

BETWEEN THE EXTREMES there is a wide area for the use of good specification practice. Sound quality standards need not limit aggressive competition. They can actually stimulate progressive material and method development. And in an essentially conservative industry, we ought to take full advantage of available knowledge and skill at every job level.

SPECIFICATIONS have a wide use. Besides the familiar job specifications, they are the language of clear understanding between suppliers and contractors, between contractors and their customers, between plant electrical departments and their management. The tight, imperative phrases are an essential operating tool of the industry. Like all good tools, they are most useful in the hands of skillful craftsmen who know their advantages and their limitations.

Wm. F. Stuart



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Whether your customers need 5-hp motors or 1/100-hp motors, Graybar can provide the best one for each job. We distribute G-E motors, of which there are more in use than *any* other kind. That's because—AC or DC, general- or special-purpose —they deliver the desired power smoothly and steadily. G-E "Tri-Clad" motors have extra protection against physical damage, electrical breakdown, and operating wear.

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ELECTRICAL SPECIFICATIONS

A manual of specification procedure with master specification for electrical construction and installation.

SPECIFICATIONS are the special language of construction. With the plans they form the contract documents. They tell "what," "when" and "how" in a way that defines with appropriate accuracy the type and quality of materials, the standard of workmanship, and all else that must be held within a reasonable range of choice or practice.

In electrical work, specifications are more important and often more critical than in other major crafts. There are wide varieties of factory made materials and equipment from which desired quantities must be selected, yet sufficient freedom is necessary to provide for reasonable operation of engineering and commercial initiative.

No other craft, in addition, needs such a range of skills and know-how in installation and workmanship.

Though electrical work involves only a small portion of total construction costs, it is vital to useful occupancy. It is often the most critical measure of whether a structure is modern or obsolete. The quality of materials, the adequacy of layouts and the excellence of workmanship in electrical work have a critical relationship to building values and usefulness far exceeding the moderate cost differences between good and poor practice. Electrical work, therefore, deserves good specifications which will clearly establish performance in keeping with the purpose, use and expected life of the structure.

In the following pages we have brought together a master electrical specification which is intended to provide a framework and, to a large extent, the substance of a good specification. It is designed for maximum usefulness to the contractor, engineer or architect who must, in the course of his work or profession, write or develop electrical specifications.

In this, the fourth revision of the project, the specifications have been extensively revised and enhanced with new material, much of which is based upon developments in the industry in recent years.

Material and guidance have been drawn from many sources including Federal and State specifications, and the specifications of several leading architects and engineers. The work has been prepared and developed by the editors from many years of practical experience with electrical specification and with the execution of electrical contracts.

It has been necessary, for clarity and simplicity, in a number of instances, to specify a particular material where some manufacturers may use other materials of equal or superior quality for the purpose. For instance an outlet box specified as galvanized sheet steel might for the purpose be equal or better if made from aluminum, cast iron or other material. It is presumed that the reader is sufficiently familiar with materials and practices to recognize these limitations and in his own specifications change or expand the range of materials to include alternatives suitable for particular jobs.

Where there are several alternative methods or materials we have given the more common ones. In such instances those given are not necessarily exclusive.

No master specification can take the place of competent engineering, well executed plans, or experienced design and layout. No more can they, however tightly written and enforced, eliminate the necessity for contracting with firms of known worth, skill and experience. Contractors, engineers, architects and others concerned with specification writing or with detailing more broadly written specifications of others will find this master electrical specification a useful check on present practice, a source for expanding, rewriting or bringing up-to-date their own standards and a means of clarifying proposals.

Though we have been conscientiously fair and unbiased with respect to manufactured materials, preferences for particular brands and qualities are the very essence of good specifying. From the architect who, at the professional level, writes a performance specification around a product he knows and respects, to the contractor who must eventually convert his preferences into specific names and catalog numbers on the purchase order, product preference eventually establishes the quality and characteristics of the electrical job. So the work of the manufacturers who display and describe their products, and who seek to esablish their special worth or superiority, must be considered an important and most useful part of this Specification.

TABLES

1.1 General Conditions

The General Conditions of the Contract as published by the American Institute of Architects is recommended as the basis for this part of the specification. The following index indicates the subjects:

1. Definitions.
2. Execution, correlation and intent of documents.
3. Detail drawings and instructions.
4. Copies furnished.
5. Shop drawings.
6. Drawings and specifications on the work.
7. Ownership of drawings.
8. Samples.
9. Materials, appliances, employees.
10. Royalties and patents.
11. Surveys, permits and regulations.
12. Protection of work and property.
13. Inspection of work.
14. Superintendence: supervision.
15. Changes in the work.
16. Claims for extra cost.
17. Deductions for uncorrected work.
18. Delays and extension of time.
19. Correction of work before final payment.
20. Correction of work after final payment.
21. Owner's right to do work.
22. Owner's right to terminate contract.
23. Contractor's right to stop work.
24. Applications for payments.
25. Certificates of payments.
26. Payments withheld.
27. Contractor's liability insurance.
28. Owner's liability insurance.
29. Fire insurance.
30. Guaranty bonds.
31. Damages.
32. Liens.
33. Assignment.
34. Mutual responsibility of contractors.
35. Separate contracts.
36. Subcontracts.
37. Relations of contractor and subcontractor.
38. Architect's status.
39. Architect's decisions.
40. Arbitration.
41. Cash allowances.
42. Use of premises.
43. Cutting, patching and digging.
44. Cleaning up.

Subjects particularly applicable to electrical installations follow, the numbers indicate where they may be inserted in the above index.

2. Scope of these Specifications.

The work to be done under these specifications shall include the furnishing of all labor and material required to complete and leave ready for operation the installation of the following items, in accordance with these specifications and the accompanying drawings:

(List here each system that is to be included in the electrical contract, such as wiring for lighting; power; special systems—radio, telephones, paging, etc. If only installation labor is required for certain work, so state.)

3. Drawings.

These specifications are accompanied by floor plans of the building showing the location of all outlets and the switch control:

a. The layout of the branch circuits

b. A riser diagram.

The drawings and these specifications are complementary each to the other and what is called for by one shall be as binding as if called for by both.

9. Standards for Material and Workmanship.

All materials shall be new and shall conform with the standards of Underwriters' Laboratories, Inc., in every case where such a standard has been established for the particular type of material in question. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance when completed.

11. Codes, Permits and Inspections.

The installation shall comply with all laws applying to electrical installations in effect, with the regulations of the National Electrical Code where such regulations do not conflict with the laws in effect, and with the regulations of the public utility company furnishing the electric service.

(In localities where electrical installations are governed by municipal ordinances.) The contractor shall obtain all permits required by the ordinances of the city of ..... and after completion of the work shall furnish to the owner or architect a certificate of final inspection and approval from the electrical inspection department of the city of .....

(In localities where no ordinance governing electrical work is in effect.) After completion of the work the contractor shall furnish to the owner or architect a certificate of final inspection and approval from the Underwriters' Inspection Bureau having jurisdiction.

30. Guarantee.

The contractor shall leave the entire electrical system installed under this contract in proper working order and shall, without additional charge, replace any work or material which develops defects, except from ordinary wear and tear, within one year from the date of the final certificate of approval issued by the inspection department.

When a part of the electrical system is placed in service prior to the date of final approval, that particular system or partial system shall then commence its one-year period of guarantee. This guarantee shall expire one year after such systems or partial systems are placed in service, without regard to the date when the final certificate of approval covering the entire system is granted.

1.3 PROCEDURE

Plans and specifications should provide a clear description of the work. They should be free of ambiguity and should limit the range of alternative materials or methods to definite commercial quality standards.

1.31 INDUSTRY STANDARDS

Wherever possible the plans and specification should be sufficiently explicit to describe clearly and exactly the types of material and the quality of workmanship desired. Widely recognized standards of practice or the requirements of local or national codes which apply to the project are usually included in the specification by reference.

Standards may include the National Electrical Code; the standard rules of the American Institute of Electrical Engineers; The National Electrical Manufacturers Association Standards; The Insulated Power Cable Engineers Association; National Bureau of Standards; National Electrical Safety Code; and the rules and regulations of the Local Utility.

The following standards shall be considered as minimum requirements for this project: The National Electrical Code; The National Electrical Safety Code; the service regulations of the ..... Power Company.

1.32 DRAWINGS

When the building plans are not too complex, and not too densely traced with structural details, all elec-

GRAPHICAL ELECTRICAL SYMBOLS FOR ARCHITECTURAL PLANS

GENERAL OUTLETS

Ceiling Wall.

- ⊙ —○ Outlet.
- Ⓑ —Ⓑ Blanked Outlet.
- Ⓓ Drop Cord.
- Ⓔ —Ⓔ Electrical Outlet; for use only when circle used alone might be confused with columns, plumbing symbols, etc.
- Ⓕ —Ⓕ Fan Outlet.
- Ⓙ —Ⓙ Junction Box.
- Ⓛ —Ⓛ Lamp Holder.
- $Ⓛ_P$ —$Ⓛ_{PS}$ Lamp Holder with Pull Switch.
- Ⓢ —Ⓢ Pull Switch.
- Ⓥ —Ⓥ Outlet for Vapor Discharge Lamp.
- Ⓧ —Ⓧ Exit Light Outlet.
- Ⓒ —Ⓒ Clock Outlet. (Specify Voltage)

CONVENIENCE OUTLETS

- Duplex Convenience Outlet.
- 1,3 Convenience Outlet other than Duplex. 1=Single, 3=Triplex, etc.
- WP Weatherproof Convenience Outlet
- R Range Outlet
- S Switch and Convenience Outlet.
- R Radio and Convenience Outlet.
- Special Purpose Outlet. (Des. in Spec.)
- Floor Outlet.

SWITCH OUTLETS

- S Single Pole Switch.
- S_2 Double Pole Switch.
- S_3 Three Way Switch.
- S_4 Four Way Switch.
- S_D Automatic Door Switch.
- S_E Electrolier Switch.
- S_K Key Operated Switch.
- S_P Switch and Pilot Lamp.
- S_{CB} Circuit Breaker.
- S_{WCB} Weatherproof Circuit Breaker.
- S_{MC} Momentary Contact Switch.
- S_{RC} Remote Control Switch.
- S_{WP} Weatherproof Switch.
- S_F Fused Switch.
- S_{WF} Weatherproof Fused Switch.

SPECIAL OUTLETS

⊙ a,b,c, etc
a,b,c, etc
S a,b,c, etc

Any Standard Symbol as given above with the addition of a lower case subscript letter may be used to designate some special variation of Standard Equipment of particular interest in a specific set of Architectural Plans

When used they must be listed in the Key of Symbols on each drawing and if necessary further described in the specifications.

PANELS, CIRCUITS, AND MISCELLANEOUS

- Lighting Panel.
- Power Panel.
- Branch Circuit; Concealed in Ceiling or Wall.
- Branch Circuit; Concealed in Floor.
- Branch Circuit; Exposed.
- Home Run to Panel Board. Indicate number of Circuits by number of arrows.
  Note: Any circuit without further designation indicates a two-wire circuit. For a greater number of wires indicate as follows: (3 wires) (4 wires), etc.
- Feeders. Note: Use heavy lines and designate by number corresponding to listing in Feeder Schedule.
- Underfloor Duct and Junction Box. Triple System.
  Note: For double or single systems eliminate one or two lines. This symbol is equally adaptable to auxiliary system layouts.
- Ⓖ Generator.
- Ⓜ Motor.
- Ⓘ Instrument.
- Ⓣ Power Transformer. (Or draw to scale.)
- Controller.
- Isolating Switch.

AUXILIARY SYSTEMS

- Push Button.
- Buzzer.
- Bell.
- Annunciator.
- Outside Telephone.
- Interconnecting Telephone.
- Telephone Switchboard.
- Ⓣ Bell Ringing Transformer.
- D Electric Door Opener.
- F Fire Alarm Bell.
- F Fire Alarm Station.
- City Fire Alarm Station.
- FA Fire Alarm Central Station.
- FS Automatic Fire Alarm Device.
- W Watchman's Station.
- W Watchman's Central Station.
- H Horn.
- N Nurse's Signal Plug.
- M Maid's Signal Plug.
- R Radio Outlet.
- SC Signal Central Station.
- Interconnection Box.
- Battery.
- Auxiliary System Circuits.
  Note: Any line without further designation indicates a 2-Wire System. For a greater number of wires designate with numerals in manner similar to———12-No. 18W-¾" C., or designate by number corresponding to listing in Schedule.
- a,b,c Special Auxiliary Outlets.
  Subscript letters refer to notes on plans or detailed description in specifications.

trical outlets and wiring may be indicated thereon. A separate tracing of each floor devoid of details not essential to the electrical work is recommended for the preparation of most wiring plans. A feeder or "riser" diagram should also be made where there are three or more feeders. These riser diagrams may include schematic explanations of special systems, such as private intercommunicating telephones, stairway controls, remote controlled motor details, etc.

The wiring plans, and general plans as well, should show at their locations all outlets, switches, motors, controllers, auxiliary electrical equipments, panelboards, service equipment, and such special system outlets as signals, telephones, clocks, exit lights, etc. The wiring plans should show the completed wiring details which are in most cases too complex to indicate clearly upon detailed structural plans.

The specifications should contain a complete list of all pertinent drawings, and the following is a typical specification reference to the drawings.

The following drawings accompany this specification and are hereby made a part thereof.

No.	Title
E 1	Plot plan and underground feeders
E 2	Riser diagram
E 3	First floor plan
E 4	Second floor plan
E 5	Fixture details
E 6	Service entrance details

The drawings and their specifications are complementary each to the other and what is called for by one shall be as binding as if called for by both.

The steps to follow in preparing the wiring plans are:

Initial space provisions: Obtain tentative location and type of service, especially if current is to be supplied by the power company, based on the approximate demand for the building. Assign liberal spaces and clearances to accommodate service raceways, service equipment, transformer station, and main distribution center. Final details can be determined only after the layout is completed and the load has been computed.

Lighting layouts: Locate and mark by standard symbol all (1) lighting outlets, (2) convenience, appliance, heavy-duty or other special outlets, local or multilocation switch controls (show outlets they control), (3) special lighting equipment built in to architectural features of the space, (4) outlets or in-built lighting equipment in fixtures, furnishings or machines, lighting panelboards. Determine circuit distribution, inter-connect outlets, and assign circuit numbers. Where the wire is larger than No. 12, show the size, the number of wires per run, and the size of raceway to be used. Underfloor systems are preferably shown on separate plans. Manufacturers can provide typical floor plans.

Power layouts: Locate and mark by standard symbol all (1) motors, (2) controllers, (3) stationary heating devices, (4) remote control and auxiliary control devices, (5) power panelboards. Determine branch circuit distribution, wire and raceway size, and assign circuit numbers.

Where any considerable number of motors is to be wired for, the location of each motor and other power equipment, such as heaters, should be shown on the plans, also showing the hp. or kw. rating, the kind of machine driven and the location of the controller. It is well to assign a number to each motor and to prepare specification sheets giving for each motor or heater its number, location, hp. or kw. rating, description of machine driven and type of controller to be used.

Auxiliary system layouts: Locate and mark by standard symbol, all (1) auxiliary system outlets, such as telephones, gongs, annunciators, etc., (2) junction or terminal cabinets, (3) batteries, transformers, or other power supply sources. Determine circuit routing or subdivision, indicate on plans and riser diagram, and provide for panelboard circuits to supply auxiliary systems.

Circuit runs: For concealed work in fireproof construction, circuit runs should as far as possible be shown as straight lines from outlet to outlet. For concealed raceway work in wood joist construction, right angle bends must as a rule be used and it is preferable to lay out the work in such manner as to indicate such bends on the wiring plan. For exposed work the approximate actual position of the runs should be shown.

Abusive or hazardous area design: Isolate or place in a separate room wherever possible all equipment the safe or successful operation of which would be affected by (1) abrasive metals, dusts and chips, (2) condensation, (3) corrosive atmospheres, (4) excessive temperatures, (5) grease and oil, (6) excessive vibration, (7) water drippage or splashing, (8) explosive dusts or fumes, (9) ignitible fibres, flying or accumulations (10) flood water. Provide sealing fittings in raceways leading to rooms of widely different temperatures, to prevent air circulation within such raceways.

Final calculations: Calculate, route and indicate on plans and riser diagram the complete feeder system, main distribution equipment, and service equipment.

Tracing methods: In addition to using standard wiring symbols, the wiring plan tracings will be more easily checked in the office during the progress of design during construction, or in case of revisions, by employing various colors of tracing ink to distinguish between lighting, power, signal, telephone, fire alarm or special systems.

To prepare complete wiring layouts, various standards, recommendations, or engineering data, are needed for determining loads, number of outlets, controls, or routing of circuits.

The data tables in section 10.1 will provide much of the basic information necessary.

Lighting outlets: In many cases, particularly in industrial plants, either the various classes of work to be done have not been assigned to definite spaces in the building when the wiring layout is made, or there is a probability that at some future time machines and other equipment will be relocated. In all such cases, wiring capacity should be provided that will be sufficient for the maximum probable need.

The first step in laying out a wiring system is to determine the outlet locations and loads.

As the architectural features of the room or space become more important, the choice in the location of outlets becomes more and more restricted. Extreme cases are churches, theatres and similar buildings of somewhat elaborate architectural treatment, where the lighting equipment, whether concealed or exposed, must be located so as to fit properly in its surroundings, otherwise the effect is crude and displeasing. Similar conditions may be met in some retail stores, hotel and office building lobbies, lodge halls, libraries, banking rooms, etc. At least a preliminary design of the lighting system should be made in these cases before the wiring is laid out.

Any space that is to be occupied as an office in an industrial building is to be treated as an office, while a workshop in a commercial building is to be treated as industrial.

Incandescent lighting loads: To determine the wattage loads after the outlets have been located, take the

watts per square foot required, for the given case multiply this figure by the total area of the space, in square feet, to find total watts. This result divided by the total number of outlets gives the computed watts per outlet.

Example: A retail store sales room measures 45 ft. by 96 ft. and there are 18 ceiling outlets. Single-lamp fixtures are to be installed. What is the proper wattage per outlet? The standard load is 4 watts per sq. ft.

45 by 96 = 4320 sq. ft. total area

4,320 by 4 watts = 17,280 watts

$\frac{17,280}{18}$ = 960 watts per outlet

This wattage should then be adjusted to 1000, this being the nearest commercial lamp rating.

In those cases where an illumination system has been designed and specified to produce values of illumination intensity lower than the maximum values referred to above, the wiring layout nevertheless should be based upon the standard lighting load tables.

If no occupancy corresponding to the given case is listed in the tables, a preliminary illumination design will determine the watts per outlet.

Fluorescent lighting loads: To determine loads required for fluorescent lighting an illumination design must be prepared for typical areas and the watts per square foot determined for each type of lighting application. For instance a school project would require a class room layout, auditorium layout, corridor layouts, etc. In each case the watts per square foot required would then be applied to all similar areas in the building.

Convenience outlets: In retail stores the use for which convenience outlets are intended should be carefully considered. The general recommendation is not over six outlets per circuit but in many cases this number should be reduced. Only one outlet per circuit may be desirable in certain cases.

Outlets for show window lighting should usually be located on the sides of the columns, at or near the height at which the lighting equipment is to be located.

Floor outlets for show case lighting should be located from final plans showing the exact locations of the store fixtures. In a small store having an unfinished basement, circuits may be carried down from the cabinet to a junction box in the basement. These circuits may be run to the desired locations after the fixture locations have been determined.

Outlets for wall case lighting can usually be located in the wall so as to be just above the cases. Wiring can then be extended on the tops of the cases to the lighting equipment. Where display cases back of the counters and on the column lines are to be lighted, outlets may be located on the column just above the cases, or if this is not feasible, floor outlets must be provided.

Lighting branch circuits: Having determined the outlet location and the watts per outlet, or outlets per circuit, the number of branch circuits should next be determined. It is preferable to make a final check by laying out the circuits on the floor plans. The number of circuits for general illumination is determined from the outlet wattage, and the usual limit is 1000 watts per circuit.

Heavy-duty branch circuits: Where the entire load on a circuit consists of mogul-base lamps or mercury-vapor lamps, special high capacity circuits may be used. These are known as "heavy-duty circuits." These circuits may consist of No. 12, No. 10, or No. 6 wire, with overcurrent protective devices rated or set at 20 amp., 30 amp., or 50 amp., respectively.

For mogul-base incandescent lamps, these high capacity circuits should be so laid out that the initial load may be increased by substituting lamps of the next larger size. Circuits of No. 12 wire need not be considered because with this size the voltage drop would be excessive unless the circuits are very short. For circuits of larger wire the initial loading should not exceed 1500 watts for No. 10, nor 3000 watts for No. 6.

A 15 amp. circuit should not exceed 1000 watts initial, hence for any higher wattage it is necessary to use heavy-duty circuits if single-lamp fixtures are to be used. Thus if each bay measures 18 ft. by 20 ft. and 4 watts per sq. ft. is required, with one outlet in the center of each bay, the wattage per outlet is 360 x 4 = 1440 watts. For single-lamp fixtures a heavy-duty circuit of No. 10 wire or larger should be run to each outlet, or No. 8 or No. 6 wire may be used with two outlets per circuit.

Voltage drop: The voltage drop on lighting branch circuits should preferably not exceed 2 percent. It is not practical to calculate the wire size for every circuit, because too much time would be required to make the calculations, and in order to avoid unnecessary complication it is better to use not more than two sizes of wire.

A sufficiently close approximation to the desired voltage drop will be obtained by following the table for wire sizes and voltage drop in 10.1.

Receptacles must have a rating not less than the load they serve and when connected in branch circuits must be rated as follows:

15 amp. circuits – not over 15 amp. rating

20 amp. circuits – 20 amp rating

30 amp. circuits – 20 or 30 amp. rating.

50 amp. circuits – 50 amp. rating

Exception permits medium base lampholders on 20 amp. circuits where only fixed lighting equipment is served, 15 amp. receptacles on 20 amp. circuits supplying only small appliances as in appliance circuit.

Motor and heating device outlets: The size and type of motor or heating device to be indicated on the plans is nearly always determined by specific units of mechanical equipment. Therefore, the discussion with respect to design procedure for power wiring must be based on the assumption that such equipment has been definitely selected before plans are prepared.

Outlet locations: In most cases the location of machinery such as pumps, compressors, elevators, blowers, etc., is fixed because of structural or other important mechanical design features. Therefore, the motor or heating device location is largely dictated by the machinery location.

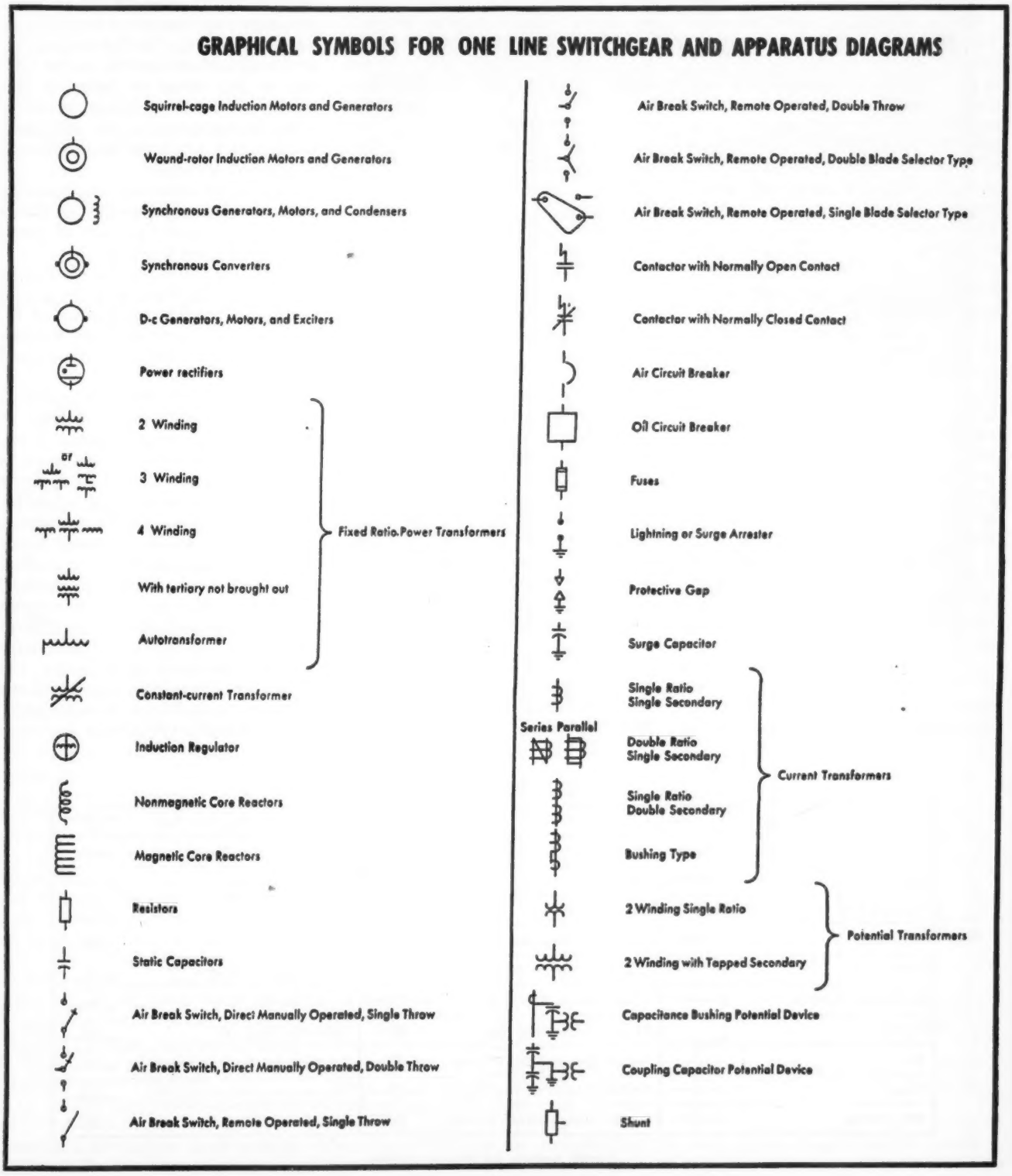
Controller locations: Particular care must be given to locate control equipment for maximum accessibility, to save steps, and to isolate it from mechanical injury or deterioration from dripping water, vapors, etc. To meet one or more of these conditions often necessitates a carefully chosen controller location at a remote out-of-danger place. Therefore one or more remote-control pushbutton stations are usually located nearby or upon each machine. In addition various auxiliary combinations of limiting switches or tripping devices may be selected or may already be included as integral machine equipment. The wiring plans should indicate clearly the locations of such controlling devices and the raceway routings to be followed when wiring connections are not already provided for them on the machine.

In grouping at one location two or more assemblies of controllers, disconnecting switches, resistors, and other auxiliary devices, show on wiring plans such details as are necessary to assure the fabrication of supporting frameworks and the proper alignment or positioning of raceways.

To determine the detailed requirements for motor controllers and their disconnecting means see Article 430 of the National Electrical Code. Where a motor controller is not located within sight of its motor, the controller must usually be capable of being locked in the open position. A manually operable switch designed to prevent the starting of a motor may be located within sight of remote controlled motors. This switch may be placed in the remote control circuit of the remote control switch or switches, or it may disconnect the motor branch circuit conductors.

Branch circuits: Wiring connections should indicate (1) whether raceways are to be run concealed or exposed between the motor or heating device and its control equipment, (2) whether run overhead or on the floor and (3) the exact location for terminating the raceway beside the motor.

Many motors and heating devices, as for printing press and laundry equipment, are mounted on machines with or without machine-mounted controllers. For such cases, particularly in concealed home-runs, the wiring plans should indicate the exact raceway termination at each machine.



When a machine is supplied with all its wiring installed by the manufacturer, state this condition, whereas the complete details of all wiring that is to be attached to machines by the wiring contractor should be indicated on the wiring plans.

For motors or heating devices that are located in areas having floors subject to seepage or prevalent moisture, the raceways may in some cases be routed overhead to avoid traps or water pockets.

Outlet and equipment location: The wiring plans must show outlet locations for exit and emergency lights to comply with the National Electrical Code, state and local fire or safety regulations. The locations of equipment for non-compulsory systems such as annunciators, loudspeakers, etc., should be chosen for ready access, step-savings, audibility or visibility. Transformers, charging devices, master instruments, relay panels, and junction or distributing cabinets should be located to permit easy access for maintenance.

Circuit routings should be shown on wiring plans to indicate outlet interconnection. If future extensions to the system are contemplated, the careful routing and termination of initial circuits will greatly simplify such work later on. Unless circuit or cable runs are clearly determined on the wiring plans, frequent take-offs or multi-cable splices may be attempted which would tend to complicate maintenance.

To simplify the routing and identification of auxiliary system conductors or cables, junction or terminal cabinets should be located at accessible points.

All branch circuits that supply power to auxiliary systems, such as for signaling transformers, battery chargers, converters, or for synchronous clock systems should be clearly identified within the panelboard to prevent them becoming disconnected by mistake. This is most likely to occur at panelboards from which groups of lights are turned on and off by various persons. The levers of such special circuit switches may be omitted, locked or of the key-insert type, or these switches placed in a sectional locked panelboard door.

Lighting panelboards: The simplest form of panelboard is that providing one fuse or circuit breaker for each ungrounded circuit conductor, or, for the ordinary two-wire circuit, one per circuit. For circuits under 30 amp. operating at not over 125 volts, plug fuses are generally preferred to cartridge fuses as being easier to replace and occupying less space.

Branch circuit switch control at the panelboard is commonly provided in retail stores and in large spaces where it is convenient to have a single point of control, except where a more elaborate control system is called for, as in a theatre or other assembly hall. In an apartment building, hospital, or school building, local control by means of wall switches is necessary and circuit switches on panelboards are usually single-pole.

Branch circuit breakers provide both overcurrent protection and individual circuit control.

If any heavy-duty circuits are to be used and if the load per circuit would exceed 30 amp. after replacing the original lamps with lamps one size larger, the panelboards must be especially equipped for the protection of these high wattage circuits.

Panelboards can be obtained with main fuses or a main circuit breaker. Such equipment is usually the most practical means of providing overcurrent protection for a panelboard where such protection is required. A main switch or circuit breaker may be useful if all circuits are to be controlled together; for example, a panelboard supplying show window lighting only.

Spare circuit equipment should be provided on every panelboard amounting to at least one spare circuit for each five circuits utilized in the original layout. Where the cabinet is built into the wall, provisions should be made for bringing this number of circuits out of the cabinet without channelling to finished wall. Such provision may consist of empty raceways run up from the cabinet to covered outlet boxes located in the ceiling, or run down to boxes in the ceiling of the story below, or both; or by leaving space for two additional wires in each run from the panelboard to the first outlet.

Each of the following considerations shall be given due weight in determining the required number of panelboards and their location:

Good practice limits the number of branch circuits distributed from one location or panel to a maximum of 42.

No branch circuit run from the cabinet to the first outlet should exceed 100 ft.

Panelboards should always be accessible for the replacement of fuses or the resetting of circuit breakers. If circuit switches or circuit breakers are to be used for the control of lighting equipment, convenience of access for this purpose should also be considered.

Panelboard locations should be so chosen that the feeders will be as short as possible and may be brought to the panels with a minimum of expense for bends and offsets. It is difficult and often impossible to install large conduits concelaed in the floor.

In a small building consisting of one story and a basement, a single panelboard located on the main floor may

TABLE OF SYMBOLS

Std. 10' Section (Plug-in)	P	Roof Flange		Circuit Brkr. Adptr. (Cubicle)	C
Std. 10' Section (Feeder)	F	Transformer Tap Opening	T	Section Bus Bar Adaptor	
Weatherproof Duct		Transposition		Bus Bar Extension	
Flanged End		Expansion Joint		Vacu-Break Plug	
End Closer		End Cable Tap Box		"BP" Plug	
Ebony End		End Tap Switch Box	S	Circuit Breaker Plug	
Panelboard Adaptor		Center Cable Tap Box		Circuit Master Plug	
Elbow		Plug-in Cable Tap Box		Capacitor Plug	
Tee		Plug-in Branch Run Adaptor		Grd Detector Plug (Potentializer)	
Cross		Fusible Plug-in Br. Run Adptr.		Temperature Indicating Plug	T
Wall Flange		Fusible Switch Adptr. (Cubicle)	F	Transformer Plug	

Typical symbols for busway systems.

be sufficient. For larger buildings, one panelboard per floor may be considered the minimum.

Lighting feeder capacity: The minimum sizes of feeders to provide for carrying capacity are to be based upon a load of 1,000 watts for each 15 amp. branch circuit installed, plus the total initial wattage of all heavy-duty lamp circuits, plus 500 watts for each spare circuit provided on the panelboard.

A demand factor as permitted by the National Electrical Code may be applied to the total wattage. This demand factor will be 100 percent for all retail stores and for small buildings of any occupancy.

Having determined the maximum demand in watts (total computed wattage x demand factor) for each feeder, the current per feeder is calculated as follows:

Two-wire, 120 volt system

$$\frac{\text{Watts}}{120} = \text{amp.}$$

Three-wire, 120-240 volt system

$$\frac{\text{Watts}}{240} = \text{amp.}$$

Four-wire, three phase, 120-208-volt system

$$\frac{\text{Watts}}{360} = \text{amp.}$$

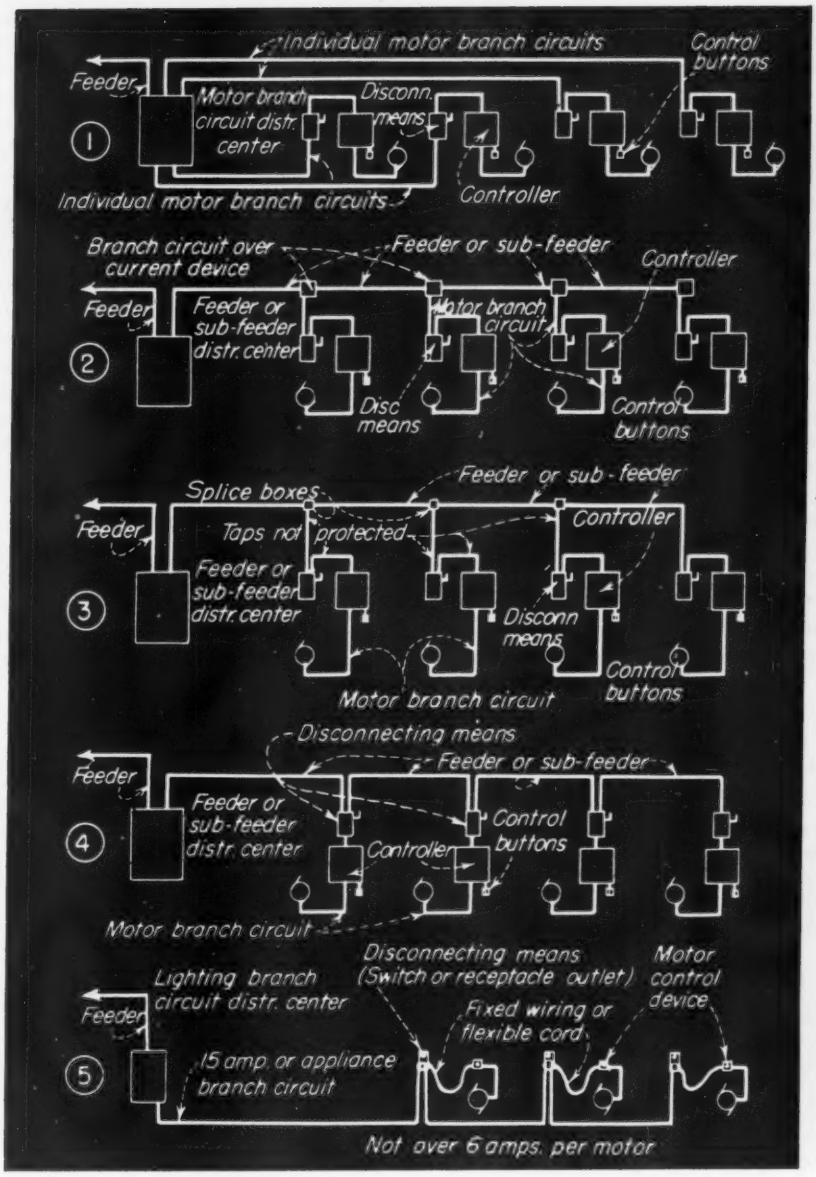
Voltage drop: A voltage drop should not exceed 1.5 percent in the feeder system from the service entrance to any panelboard. Using the maximum demand amperes computed as explained above, the size of conductors required for 1.5 percent drop should be calculated and this size should be used if it is larger than the size required for carrying capacity.

Provide for future increase in feeder capacity. All branch circuit calculations are based upon a possible future increase of 50 percent in the load on 15 amp. circuits and the substitution of lamps one size larger than the original lamps on heavy-duty lamp circuits. In order to make it possible to use this excess circuit capacity, provision must be made for a corresponding increase in the feeder capacity. This may be done (1) by installing oversize feeders originally, (2) by installing oversize conduits so that the original feeders may be replaced with feeders of larger size, or (3) by arranging the installation so that additional feeders can be installed at some future time at a minimum of expense.

(1) Where the conductor size required for the initial load is No. 8 or smaller, conductors large enough to provide for the future increase in load should be provided in the original installation. The additional cost of the larger conductors in such a case will be so small as to be unimportant.

(2) Up to a conductor size of about No. 1, conduits should be installed of sufficient size to contain feeder conductors of the size required for the future increase in loading. This will usually require, if the three-wire system is used, 1½-in. conduit for No. 6 or No. 4 conductors and 2-in. conduit for No. 2 or No. 1. Then when the need arises the original conductors can be withdrawn and replaced with conductors of larger size.

(3) Where the conductors are replaced as in (2), the original conductors have only a scrap value. To avoid this waste in the case of large cables, spare conduits may be installed so that the increased capacity may be provided by installing additional feeder cables. This method, however, requires that the original layout be planned with special care. It is not good practice to multiple two conductors of unequal size, hence the installation should be planned to utilize the additional feeder capacity by sectionalizing each panelboard or by changing the connections so as to supply certain panelboards by the new feeders.



Conventional types of motor circuits.

Power feeders: Because of the varying factors in power feeder design as to routing, grouping of motors and voltage loss, five common methods of design or types of layouts must be considered.

(1) A separate circuit may be run to each motor from a branch circuit distribution center.

(2) A feeder or sub-feeder may be carried around the building with branch circuits tapped to the feeder at various points, no branch circuit distribution center being used. Busbar distribution systems with taps to individual motors come within this group.

(3) A feeder or sub-feeder may be carried around the building with subfeeder taps, having no individual overcurrent protection, carried direct to the disconnecting means or controller for each motor. In this case, the branch circuit overcurrent device is usually omitted and the motor branch circuit originates at the controller.

(4) A feeder or sub-feeder may be carried direct to the disconnecting means or controller for each one of the group of motors. Otherwise the layout is the same as in (3).

(5) A group of small motors, each having a full-load current rating not exceeding 6 amp., may be supplied by a 15 amp. branch circuit or an appliance circuit. For conditions under which each of the foregoing types of layouts can be used and installation requirements applying in each case, see the National Electrical Code.

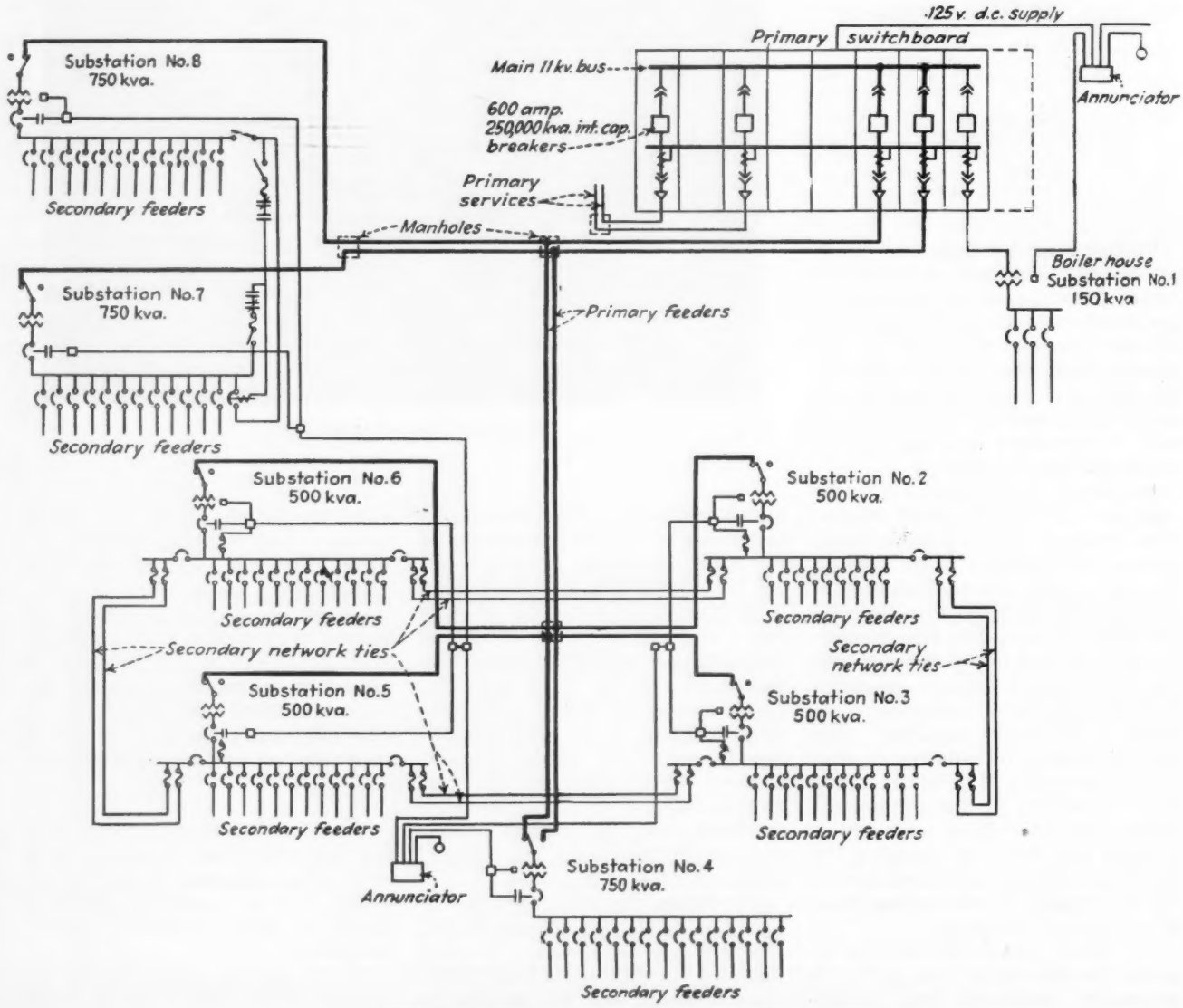
Application of various types of layouts: Type (1) can be used under any condition and is the type most commonly used. It is usually the preferable type for supplying the miscellaneous power loads in a commercial or public building and is also common in industrial plants.

The use of Types (2), which includes busbar distribution systems, (3) and (4) is chiefly in industrial plants where a large number of motors is used to drive individual machines. Type (2) requires for each motor a branch circuit overcurrent device. In Type (3), no branch circuit over-current device is required, but the conductors from the sub-feeder to the controller must be larger than in Type (2). The type (4) may show an economy in cost over either Type (2) or Type (3) if the subfeeder can be economically brought to each controller.

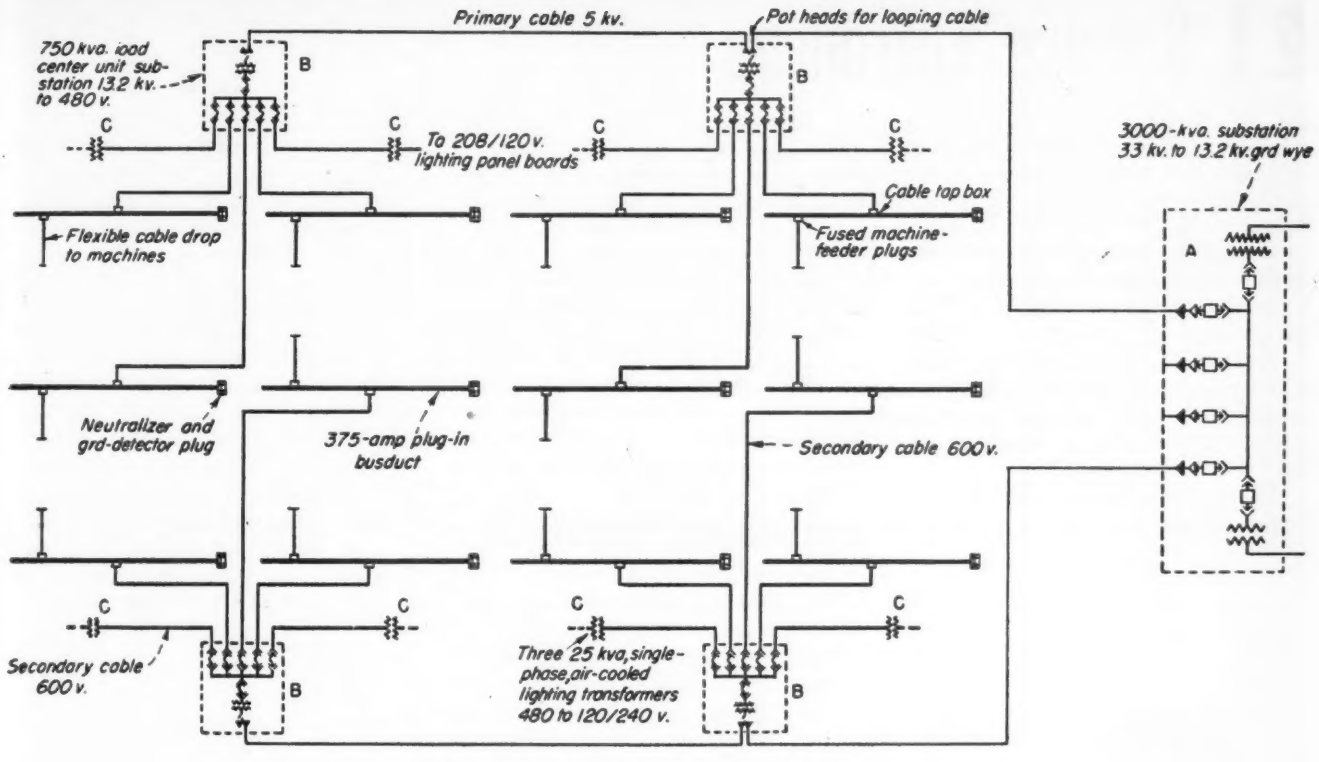
Type (5) is merely a means of providing for small motors used with household and commercial appliances, by permitting them to be connected to lighting or appliance branch circuits. This is not to be considered as a type of layout having application in a factory.

For power applications in industrial plants, the first four types of layouts may be considered as on a par as regards serviceablity. The choice between these types should be made on the basis of economy in cost of installation and flexibility, i.e., adaptability to changes in sizes and locations.

Voltage drop and carrying capacity of conductors: All conductors must have sufficient carrying capacity, ac-



Circuits and equipment in typical one line diagram.



Busway system hook-up in one line diagram.

cording to the National Electrical Code requirements, and should also be of such size that the total voltage drop to any motor will not exceed 5 percent.

On any system operating at 208 volts or higher, it is recommended that the voltage drop in motor branch circuits should not exceed 1 percent, in which case a drop of 4 percent in the feeders is allowable. It will be found that with the minimum conductor sizes permitted by the National Code, the feeder voltage drop will exceed the 4 percent limit only where a feeder is unusually long. In any case where the drop will exceed 3 percent, the annual cost of the kilowatt-hours consumed in copper losses should be computed and consideration should be given to the installation of larger conductors in order to reduce this loss.

In an industrial plant it is almost always desirable to install service and feeder conductors of larger sizes than are required for the initial load. Besides providing for load increases, the excess size will also have the advantage of reducing the copper loss.

Assemblies of externally-operable switches or circuit breakers are adaptable to all installations, small or large.

Suitable provision should be made for the protection of feeders of increased size. All that is necessary is to provide space for the future installation of larger switches or circuit breakers, and means of making connections to the larger equipment without disturbing such of the original equipment as may be retained. If a panelboard is used, it is suggested that it be of the sectional type, with space in the cabinet to contain the larger equipment and with buses large enough to carry 150 percent of the initial load. If a switchboard or assembly of unit devices is used, it is suggested that the buses be as recommended for panelboards and that the switchboard or assembly be specially designed to accommodate the larger equipment.

Service: The first step in determining the size of the service conductors and the capacity of the service equipment (switch and fuses, or circuit breaker) is to compute the total initial load by totalling the feeder loads. These should be the loads computed for the various feeders before any permissible demand factors less than 100 percent have been applied. Any power load should be segregated. By "power load" is meant any load consisting of motors or electrically heated equipment that is not to be supplied by "15 ampere" or "appliance" branch circuits as defined in the National Electrical Code.

The demand factor permitted by the National Electrical Code should be applied to the total load other than power load. In most cases, no demand factor less than 100 percent should be applied to the power load. For a single service supplying a combined load of lighting and power, the total capacity will be the sum of the lighting load after applying the demand factor, and the power load.

Provision for increased capacity: Provision having been made in the other portions of the wiring system for a future increase in the lighting load, provision should also be made for a similar increase in the service capacity.

The original installation should include service entrance conductors and service equipment having the required excess capacity in every case where the rating of the equipment, as thus determined, will not exceed 400 amp.

Where the calculated future load exceeds 400 amp., an individual study should be made of each case. Due weight should be given to each of the following considerations:

(a) In any building having an expectant life of ten years or more, it is highly probable that some additional service capacity will be needed.

(b) In most cases, additional capacity can be provided only by tearing out and completely replacing the original service conductors and service equipment and the larger the service, the greater the expense involved.

(c) Considerable additional expense is involved in providing 50 percent excess capacity in the case of a heavy service and this is a non-productive investment until some part of the excess capacity is utilized.

2.1 Service Entrances

Service entrances include the point of connection to utility service apparatus, conductors and raceways connecting to the first point of distribution within the building and the main disconnecting means.

Service entrances consist of two general types:

1. Primary services; electric service purchased, metered and connected at utility distribution voltage and transformed to utilization voltage by the user.

2. Secondary service; electric service purchased, metered and connected at utilization voltage.

Primary services are usually economical only for large properties involving heavy power consumption. Secondary service is customary for ordinary commercial and industrial buildings. Utility engineers should be consulted.

Service installations follow two general types:

1. Overhead services; open conductors run overhead from the utility pole to the point of connection.

2. Underground services; service conductors carried underground from the utility pole or vault to the point of connection on the customer's premises.

Considerations are usually economic and determined by the type of job, utility rules and safety requirements. Primary services and large secondary services in urban areas are usually underground. Residential and small commercial services are usually overhead.

Specification should indicate the type of service giving the voltage, frequency and phase characteristics.

Service shall be . . . wire, . . . phase, . . . cycle, . . . volts, furnished and connected by the . . . . . Company to the point of connection indicated on the plans.

2.12 PRIMARY SERVICES

Primary service requirements vary widely with the practices of individual utility systems. Consult with the utility engineers whenever developing specifications for a particular project.

The specification should state by whom the service is to be furnished and installed.

For primary services and feeders to substations and transformers, the following items may be covered by the specifications:

(1) Number, type, size, and voltage of cables,
(2) Number, type, and size of ducts and conduits,
(3) Type of elbows and pipe bends (wide sweep),
(4) Racking of cables (in vaults and manholes),
(5) Fireproofing of exposed cables,
(6) Grounding cable sheaths,
(7) Tagging cables,
(8) Testing cables,
(9) Concreting ducts,
  (a) Amount of concrete around ducts,
  (b) Concrete mix,
  (c) Conduit spacers,
(10) Rodding ducts,
(11) Excavating and back filling,
  (a) Depth of duct runs,
  (b) Soil conditions,
  (c) Backfilling and tamping,

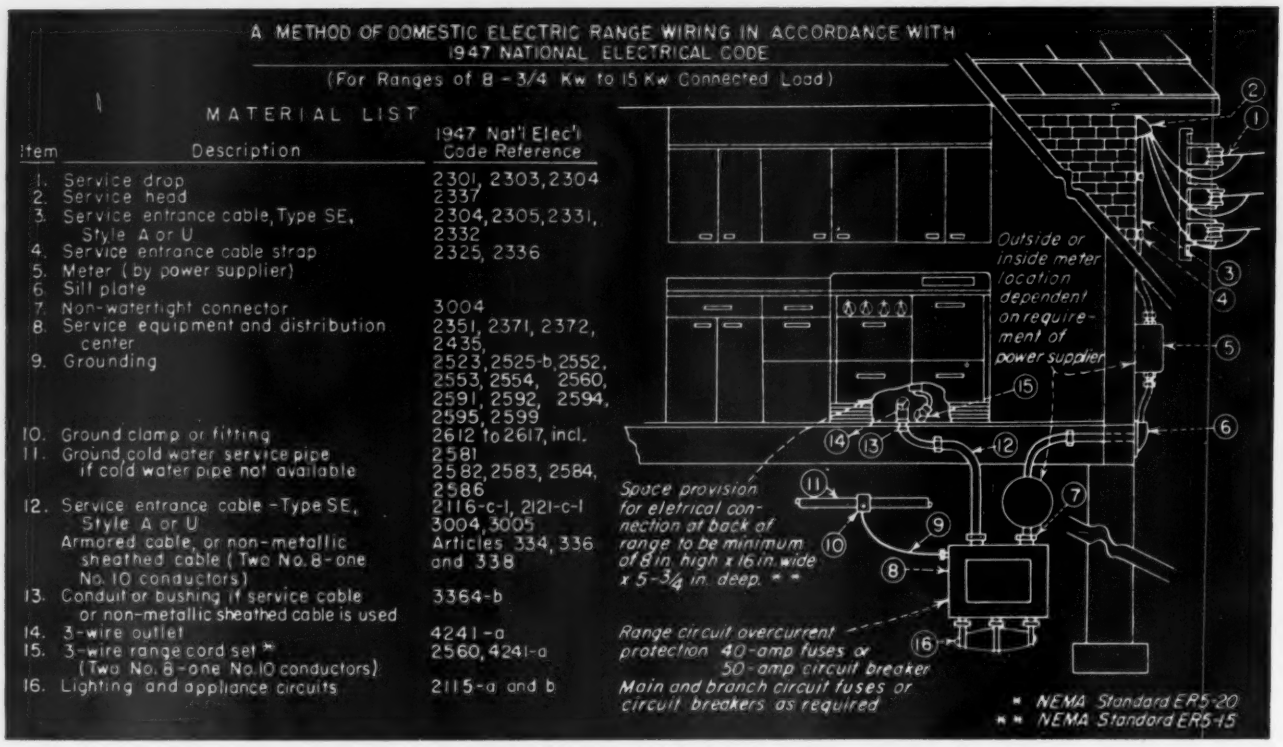
In some cases it may be necessary to specify such special items as:

(1) Re-enforcing concrete over unstable soil or under tracks and driveways,
(2) Shoring sides of trench,
(3) Pumping water.

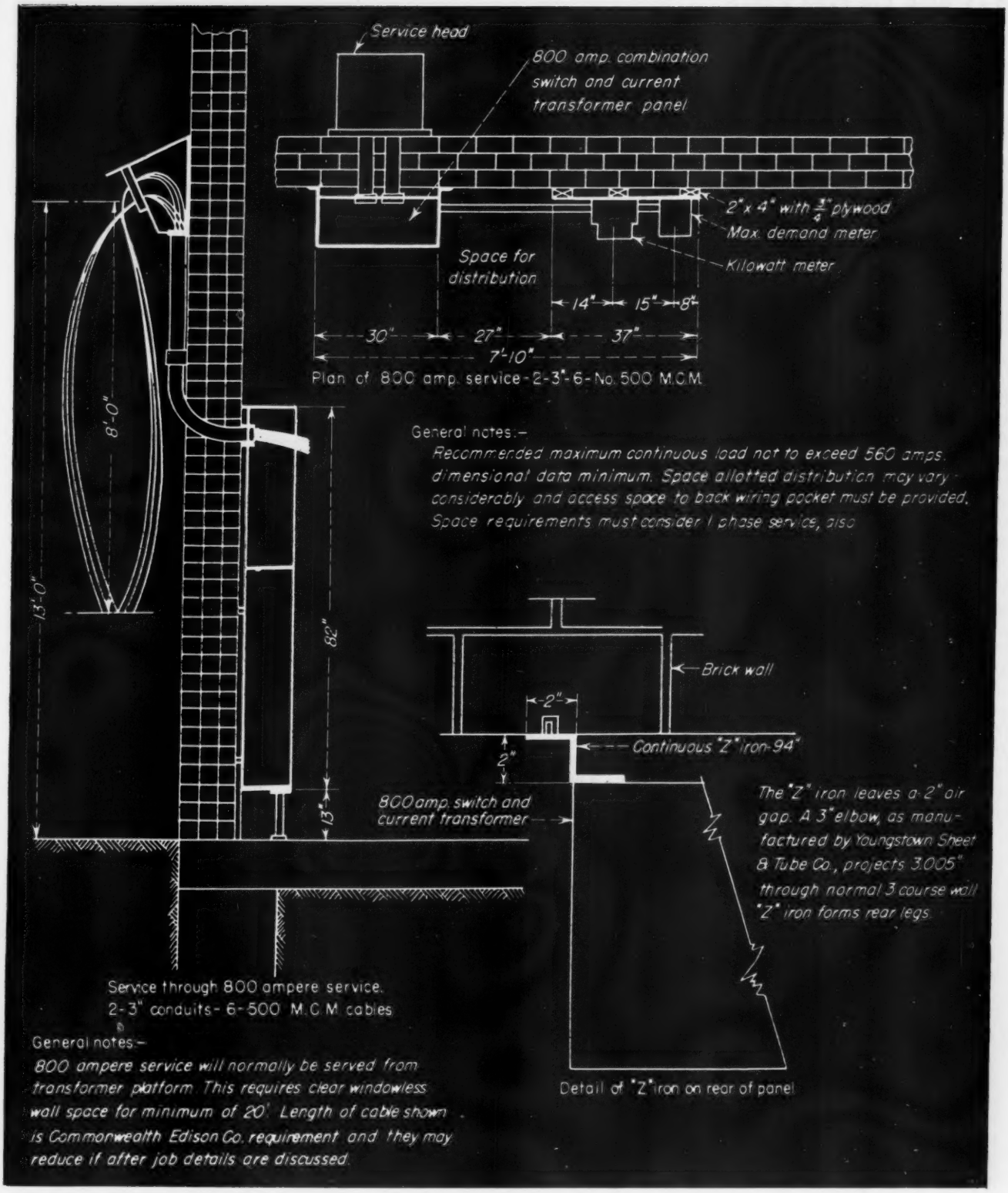
Primary Service: Furnish and install (number and size) conduits between the utility vault and the customer's vault as shown on the plans. Conduits shall be:

a. Rigid galvanized conduit.

b. Impregnated fiber conduit properly seasoned and free of defects. Conduits shall be furnished in manufacturers standard lengths and shall be of



Typical residential service details with code references.



Typical large secondary service installation.

uniform wall thickness. Joints shall be made waterproofed with an approved compound.

c. Asbestos cement conduit of the best quality installed and waterproofed at the joints according to the manufacturer's recommended methods.

Conduits shall be installed not less than . . . inches below the surface and shall grade as shown on the plans.

Conduits shall be enclosed in a concrete envelope not less than . . . inches in thickness.

Example.

Furnish and install three 4-inch conduits between the utility vault and the customer's vault as shown on the plans. The conduit shall be impregnated fiber of the best quality, properly seasoned and free of defects, furnished in the manufacturer's standard length and shall be of uniform wall thickness. Ducts shall have sleeve joints waterproofed with an approved compound. They shall be installed not less than 24 inches below the surface and graded away from the interior vault. They shall be enclosed in a concrete envelope not less than 3 inches in thickness.

2.13 HIGH VOLTAGE CABLE

All high voltage cable shall be impregnated, varnished cambric, or paper insulated, lead covered insulated for voltage and sizes as specified or shown on drawings.

Cable shall be of the very best obtainable quality, manufactured in accordance with the best acceptable practice. All such wire and cable shall be in accordance with, and conform to the latest requirements and specifications of the Insulated Power Cable Engineers Association.

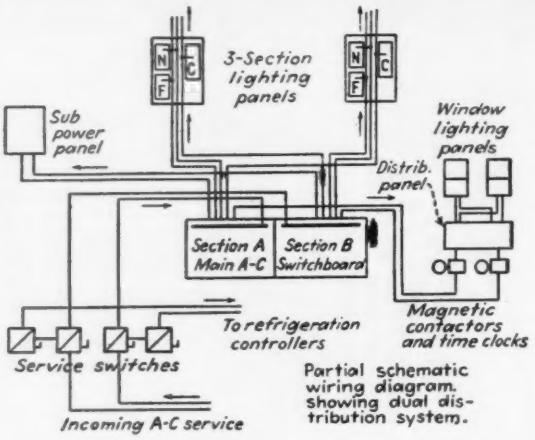
All high tension cables exposed in vaults, manholes, pull boxes or switch rooms or splice chambers and all locations not protected with conduit shall be fireproofed with two wrappings of 3/16 inch thick pure asbestos felted tape backed with coarse jute cloth and covered with at least a 3/16 inch thick smear coating of asbestos cement. The felted tape shall be immersed in a solution of asbestos cement until it has become thoroughly impregnated and then wound spirally on cable with butted joints and without lap except at bends. The second layer shall be wound spirally in the opposite direction. The asbestos cement shall consist of a chemically neutral powder guaranteed to have no deleterious effect on the lead covering or braid of the cable and to withstand immersion either constant or intermittent without effect on the fireproofing or the mechanical qualities.

Splices—All high voltage splices shall be made with an approved splice for the cable furnished, and shall be of such quality as recommended by the manufacturer of the cable furnished. Splices shall be made by workmen familiar with the art of splicing, and all such splices shall be completed once started.

Potheads: High voltage cables shall be terminated with potheads having the rated voltage and conductor capacity to accommodate the cables used. Mounting shall be as required for the conduit system installed. Potheads shall be filled with compound suitable for high voltage service. Care should be observed to avoid heating the compound to a higher temperature than that recommended by the manufacturer.

2.14 SECONDARY SERVICE

The size, voltage, frequency and source of supply should be given in the specification or on the drawings. Metering sequence and connections should be described or diagrammed and any special features explained.



Dual distribution provides two separate and independent wiring systems. Branch circuits from each serve alternate rows of lighting fixtures in all areas.

Partial schematic wiring diagram showing dual distribution system.

Services may be
a—Underground
b—Overhead

Service entrance conductors shall be run from point of connection by the utility to the service switch at the location shown on the plans.

a. Service shall consist of (number and size) conductors in rigid conduit run underground as shown on the plans.

b. Service shall be (number and size) conductors in conduit.

Conduit shall be run through the wall to a standard service ell fitting and up on the outside to a service head. The insulating cover shall be of a type which separates the conductors. Three feet of conductor shall be left extending from the service head for connections to the utility service drop. An approved bracket shall be furnished and installed adjacent to the service head for terminating the service drop. Installation shall be in accordance with the rules of the utility company.

Large secondary services may also consist of (1) enclosed bus ways, (2) specially designed bus bar structures.

In some occupancies, notably large department stores, even a momentary failure in the electrical system can be enormously expensive. Panic may occur, sales areas may be looted. At best, customers are inconvenienced and sales halted or lost. A method of wiring layout which is directed at this problem is called "dual distribution". In such systems two (or more) independent services and wiring systems are installed, each handling half the lighting load. The branch circuits are laid out so that each system serves alternate rows of lighting fixtures in all sales areas. Even major system failures can only cut the normal lighting level by half, sales activity is not interrupted.

2.15 SERVICE ENTRANCE, RESIDENTIAL

The size of service entrance conductors and the rating of service equipment shall not be less than that specified for the floor areas in the table (below). All service shall be 3 wire, 115/230 volt.

The table (below) provides service sizes adequate for normal lighting and portable appliance loads and for a range and a water heater. In addition it provides for a possible increase by the amounts shown in the last column.

Due to the continued growth in residential utilization provision should always be made for loads substantially greater than that required for conventional appliances and prevailing illumination practice.

Floor Area (Sq. Ft.)	Capacity Service Conductor (Amperes)	Rating of Service Equipment			The service capacities provided for in table are sufficient to supply lighting, portable appliances, a range, a water heater, and additional appliances, supplied by individual equipment circuits, having a total rating in watts as follows:
		Circuit Breakers	Switch and Fuse		
			Switch	Fuse	
Up to 1,000	60	70	60	60	3,500
To 1,500	65	70	100	70	4,200
To 3,000	85	90	100	90	8,800
To 4,000	100	100	100	100	9,500

2.2 Grounding

All metallic conduits, supports, cabinets and equipment shall be grounded in accordance with the latest issue of the National Electrical Code and as shown on the plans.

The carrying capacity of a grounding conductor for direct current systems shall not be less than the capacity of the largest conductor supplied by the system, except where the grounded circuit conductor is a neutral derived from a balancer, the size of the grounding conductor shall not be less than the neutral, in no case smaller than No. 8.

2.21 GROUNDING CONDUCTORS

The size of the grounding conductor, for an alternating current system, a common grounding conductor, or a grounding conductor for service equipment shall be not less than given in the accompanying table.

Conduit, pipe or electrical metallic tubing cannot be used alone as the grounding conductor for a wiring system. Wire sizes apply both to bare and insulated conductors, and are the minimum permissible.

Interior raceway and equipment: The size of the grounding conductor for conduit, cable sheath or armor, and other metal raceways or enclosures for conductors, and for equipment, shall be not less than given in the preceding table.

Size of Largest Service Conductor or Equivalent for Paralleled Conductors	For Wiring System and Service Equipment	For Service Equipment Only	For Service Equipment Only
	Copper Wire No.	Conduit or Pipe (Inch)	Electrical Metallic Tubing (Inch)
2 or smaller	8	½	½
1 or 0	6	½	1
00 to 000	4	¾	1¼
Over 000 to 350,000 C. M.	2	¾	1¼
Over 350,000 to 600,000 C. M.	0	1	2
Over 600,000 to 1,100,000 C. M.	00	1	2
Over 1,100,000 C. M.	000	1	2

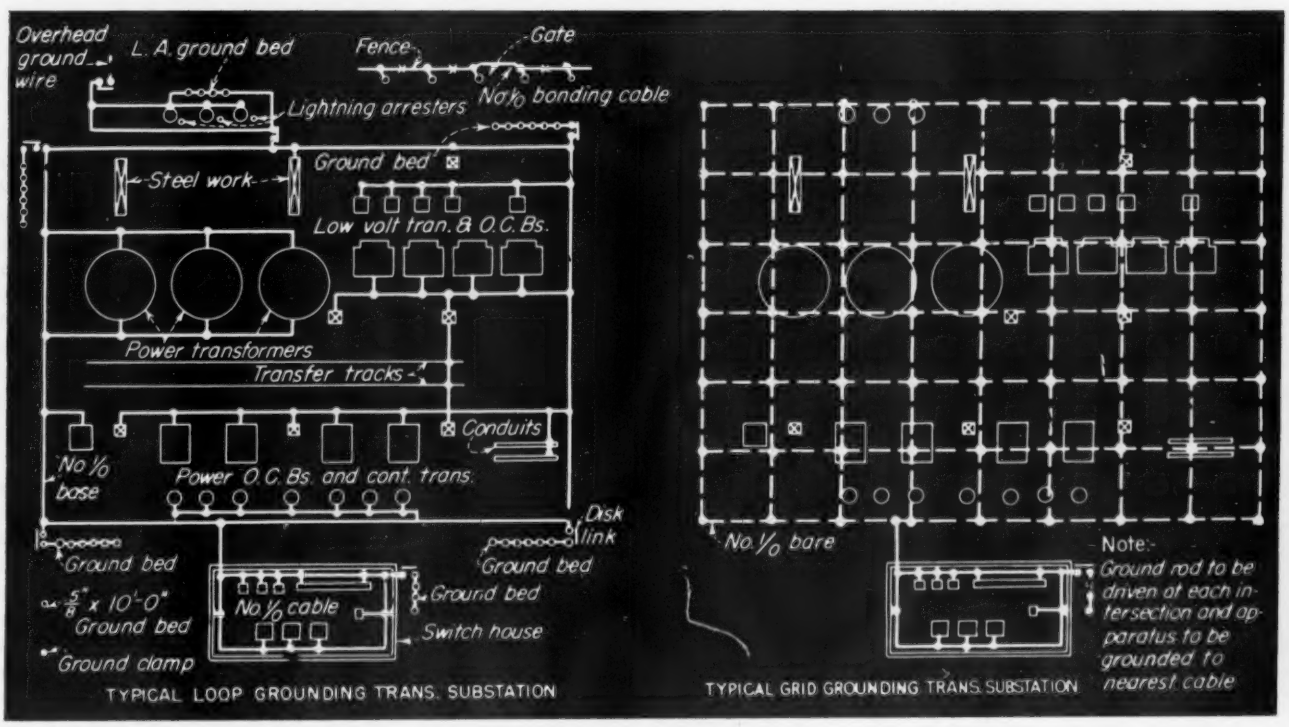
Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment Conduit, etc. Not Exceeding (Amperes)	Size of Grounding Conductor		
	Copper Wire No.	Conduit or Pipe (Inch)	Electrical Metallic Tubing (Inch)
15	16*	½	½
30	14	½	½
40	12	½	½
60	10	½	½
100	8	½	½
200	6	½	1
400	4	¾	1¼
600	2	¾	1¼
800	0	1	2
1000	00	1	2
1200	000	1	2

*Permissible only when part of an approved cable assembly.

2.22 GROUNDING LARGE BUILDINGS

Transformer tanks, three-position disconnecting switches, cubicle framework; ground bus in cubicles; cable supports and non-current carrying metallic parts of all equipment and conduits shall be securely grounded by connection to a common ground bus insofar as practicable and ground bus connected to nearest water pipe. Ground connections shall not be less than 1/0 copper, connected throughout with clamp fittings. No soldered connections shall be used in leads.

The neutral point of all secondary windings of all network or lighting transformers shall be connected to a separate grounding system. The neutral leg of the main bus at the various main switchboards shall also be connected to this ground bus at the switchboard. The ground bus and connections shall be not less than 500 MCM bare copper wire, and same shall be connected to the nearest cold water pipe. Connections shall be made



Grounding diagram of typical substation.

to this pipe with a copper or brass pipe clamp. These connections shall be made on the street side of the water meters, or jumpers shall be installed by-passing all meters. A complete system shall be installed for each vault, and same shall be in accordance with the latest edition of the National Electrical Code. All ground conductors, and taps from equipment to bus shall be made with copper, with as few connections as possible.

Bus shall be continuous without joints or splices throughout its length. All connections from bus to taps, and bus to bus shall be made with an approved type of solderless connector, and all grounding conductors shall be protected from mechanical injury, and shall be rigidly supported. If ground conductors are run through conduit they shall be securely bonded to such conduit at the entrance and exit. All connections to equipment or conduit shall be made with an approved type of solderless connector, and same shall be bolted or clamped to equipment or conduit. All contact surfaces shall be thoroughly cleaned and bright before connection is made so as to insure a good metal to metal contact.

No ground wires smaller than No. 8 shall be used, and all wires larger than No. 8 shall be bare copper cable.

2.23 GROUNDING SMALL BUILDINGS

Ground connection shall be made by connecting one end of a wire to the neutral service conductor at main switch and the other end to the cold water pipe where shown on plans. Ground wire shall be same kind and quality as other conductors in the building, shall be placed in steel conduit run as specified for branch circuits, and shall be of the size required by the National Electrical Code. Where the ground connection is made to the water pipe on house side of water meter, a jumper or shunt shall be installed around the water meter. The current-carrying capacity and mechanical protection shall be not less than required for the grounding conductor. Where a grounding conductor runs through metallic conduit, it shall be securely bonded to the conduit at the entrance and exit and the conduit shall be fitted with a bolted clamp to secure same to water pipe.

Grounding cable: Lead sheaths of underground cables shall be bonded together and grounded at each manhole. Primary underground feeder systems shall include a 500,000 CM bare conductor installed in the duct system and connected to a driven ground rod in each manhole and to underground water piping as shown on the drawings.

Grounding metal clad assemblies: Provide a ground bus with a cross-section equal to at least 25 percent of the capacity of the largest circuit. Housings shall be bolted securely to the bus.

3.1 Transformers

3.11 TRANSFORMER STATIONS

Transformer installations permit the use of high distribution voltages stepped down to utilization voltage at or near load centers. They may also provide lighting voltages from higher power voltage distribution systems.

Two developments have greatly expanded the range of practical application of transformers in interior wiring systems:

a. The metal clad unit power center, a factory-assembled combination of transformers and switchgear fully self contained and protected and designed for installation in industrial plants and large buildings.

b. Dry type distribution transformers which require no special enclosures or critical maintenance schedules and may be installed in practically any indoor location.

Transformers may be installed to operate on primary feeder distribution systems of various voltages.

Installation design details must conform to the National Electrical Code and local or state regulations. They must also meet the approval of the power supply company.

Types of stations which may be considered are:

a. Single stations supplied by primary service conductors.

b. Master stations supplied by primary service conductors, and which in turn supply two or more transformer sub-stations located in various parts of the customer premises.

c. One or more transformer stations located in various parts of the customer premises, such as different floor levels, all served by a primary distribution network.

d. Unit substations designed for installation within buildings without vault protection.

Transformer stations may be located as follows:

a. In metal clad unit substations.

b. Upon the building roof.

c. Attached to the outside of buildings.

d. Placed on the ground in suitably guarded enclosures or in underground vaults.

e. Installed above the ground upon poles or other approved supporting members.

f. In one or more approved rooms or vaults in a building.

The principal electrical requirements to be described are:

a. Interrupting capacity of primary switchgear.

b. Size and capacity of transformers.

c. Lightning arresters.

d. Disconnecting devices.

e. Grounding networks.

f. Secondary control devices.

g. Service and inside wiring, clearances, bus structures.

h. Control and metering transformers and connections.

i. Arrangement of transformers for ease of emergency isolation, and of replacement in case of burn-out.

Power centers shall be designed for (indoor or outdoor) installation. Each shall consist of a factory-assembled and coordinated combination of high voltage switchgear.

The incoming high voltage section shall consist of an externally operable gang-operated switch. (Give characteristics and rating required, air or oil insulated, load or magnetizing current break, fused or unfused, disconnect or feeder selecting, key interlocking, etc.).

The transformers shall be (give rating) kva. 3 phase, 60 cycles, high voltage ——, low voltage ——. The high voltage winding shall be provided with 2½ percent taps, two above and two below normal.

a. Air cooled transformers. The transformers shall be of the dry type, insulated with Class "B" material and shall carry full rated load continuously without exceeding 80°C rise above an ambient temperature of 40°C when cooled by natural air circulation. The transformer shall be enclosed in a sheet metal case which shall match and line up with the high-voltage and low voltage switchgear. Taps shall be brought

to a terminal board accessible by removing a panel.

b. Oil or liquid filled transformers. The transformer shall be designed for use with (oil) (noninflammable insulating liquid) and shall carry full rated load continuously without exceeding 55°C rise above an ambient temperature of 40°C.

An externally-operated, no-load tap changer, a drain valve, filling plug, liquid level gauge, thermometer and filter press valve shall be provided.

One main transformer secondary air circuit breaker, drawout type, manually operated, with adjustable time overcurrent protection, instantaneous short circuit trip. (specify rating, voltage and interrupting capacity).

Provide low voltage feeder switching section as shown with indoor-type, metal enclosures, hinged front doors, removable rear plates, copper buses and provision for bolting to the other sections, in the field to form an integral unit.

The above drawout low voltage air circuit breakers will all be equipped with safety interlocks which prevent withdrawing or inserting the breaker when it is in the closed position, manual trip button, external visual indication of breaker position, arc quenchers, and insulated closing handle for manually operated breakers.

3.12 DRY TYPE DISTRIBUTION TRANSFORMERS

Individual dry type transformers are most frequently used in industrial applications for taking lighting or special appliance loads from power circuits. Normal ratings run from 1½ kva. to about 500 kva.

The lighting transformers shown on the plans shall be single phase 60 cycle, air insulated and air cooled, two winding, dry type of the capacities shown. Primary shall be —— volts, two wire and secondary 240/120 volts 3 wire. Enclosure shall be designed for (indoor, outdoor) installation, shall be arranged for (floor, wall, pole, etc.) mounting and shall be equipped for (conduit, open) connections.

Transformers shall meet the latest requirements of the A. S. A. and shall be as manufactured by —— or approved equal.

4.1 Switches & Panels

4.11 SERVICE ENTRANCE SWITCHES FUSED

Service entrance switches shall be of the metering type enclosed in steel cabinets. Fuse types shall be so interlocked with the external switch handle that the door cannot be opened except when the switch is in the "off" position and that the switch cannot be placed in the "on" position except when the door giving access to fuses is closed. Further, when this door is open no uninsulated live metal terminal or other live metal parts whatsoever shall be accessible. Switch shall be provided with meter test facilities, brackets and meter trims.

Service entrance breakers: The service entrance switch shown shall be of the enclosed circuit breaker type. (give number of jobs and capacity rating). Breaker shall be manually operated, trip free and designed so that all poles open simultaneously. Overload tripping mechanism shall be (thermally operated, magnetically operated) and arranged to provide effective sealing against tampering. Breakers shall be approved by the Underwriters Laboratories, Inc., and acceptable under the regulations of the local utility for service entrance use.

Service entrance switches shall comply with the requirements of the Underwriters Laboratories and of the National Board of Fire Underwriters for enclosed switches or for service equipment and each switch shall bear manufacturer's name and the Underwriter's Laboratories' label. Enclosures shall be of suitable material and design for the surrounding conditions.

4.12 PANELBOARDS EQUIPPED WITH FUSES

Panelboards shall be of standard types and the product of established manufacturers. The capacity of switches and fuses shall be as shown. Each circuit shall be provided with fuses in all poles except neutral.

Pull out type switches shall be dead front when closed and fuses shall be dead in the open position. Branch circuit panels shall be dead front with switches and fuses. Switches shall be heavy duty tumbler type.

4.13 PANELBOARDS WITH CIRCUIT BREAKERS

Branch circuit panelboards shall be the dead front safety type equipped with circuit breakers. Busbars shall have lug connections for attaching feeders and arranged for wire mains and two wire branches, unless otherwise noted on drawings. The grounded side of each branch circuit shall be fed direct from the neutral busbar located at top of panel. The circuit breaker shall control the ungrounded side.

Distribution panelboards shall be of the dead front safety type equipped with circuit breakers. Busbars shall have lug connections for attaching feeders. The sizes of circuit breakers shall be as noted on drawings and unless otherwise noted shall be double pole for 3 wire single phase or 3 pole, for 4 wire, 3 phase 250 volt circuit breakers, with the neutral connected to common busbar at top of panel for grounded connecting circuit conductor and feeders on neutral systems.

4.14 SWITCHBOARD WITH CIRCUIT BREAKERS

Switchboard shall be the dead front safety type consisting of panels and circuit breakers of the number and sizes shown on the drawings. The construction shall consist of a structural or formed steel frame carefully built into a rigid structure which shall maintain its alignment and not be damaged in shipment or erection or by stresses resulting from short circuits. The frame shall be completely enclosed on front and sides with sheet steel plates. Adequate ventilation shall be provided. A pull box of the same type of construction shall be provided at the top of each switchboard which shall match the switchboard in dimension and finish. Bottom of pull box shall be slate or asbestos board and cables to circuit breaker studs dropped vertically through individual openings in bottom to their respective studs. Switchboard shall be sectionalized to permit access to the circuit breakers.

Buses on switchboard shall be of hard drawn copper of 98 percent conductivity. Connections shall be bolted and laminations interleaved to secure maximum contact areas. All laminations shall have a ¼ inch space between them. All buses and circuit breaker stub connections shall be of such size as to limit the temperature rise to 30 degrees Centigrade when carrying full-load current at room temperature, but not to exceed a current density of 1000 amperes per square inch. Buses shall be arranged for single phase 3 wire, 3 phase 3 wire, or 3 phase 4 wire distribution as shown on drawings.

4.15 CABINETS

All cabinets shall be made of sheet steel. Cabinets for panelboards shall provide proper space for all wires and connections.

Cabinets for telephone terminal strips and connection points shall be of sizes and depths noted on plans.

Cabinets shall be of standard make and shall bear the manufacturer's name plate or stamp and the Underwriter's Laboratories inspection label.

Fronts for flush cabinets shall consist of sheet steel frame and a hinged door with catch and lock. Frame shall be about ¾ inch larger than cabinet on all sides and shall be set with its back flush with the finished wall.

Telephone and signal cabinets for surface mounting shall be equipped with a door hinged directly to cabinet. Door shall be made of one piece of sheet steel and shall have a ¾ inch flange around all edges shaped to cover edge of box and equipped with catch and lock.

Lighting and power cabinets for surface mounting shall be equipped with a sheet steel frame and hinged door with catch and lock. Frame shall be the same size as cabinet and shall completely cover wiring gutter.

Each cabinet shall be furnished with a catch and flat key lock. All locks shall be fitted to the same key. Furnish keys for each job.

All cabinets shall have proper means for securing, supporting, and adjusting the panelboards and fronts. Cabinets shall be arranged to provide a wiring gutter not less than 3 inches wide for panelboards up to 31 inches high and not less than 4 inches wide for larger panelboards.

Lighting and power cabinets shall be installed with tops 6 feet 6 inches above floor, and telephone cabinets shall have bottom just above baseboard. Telephone and signal cabinets in ground floor shall be installed with tops 6 feet 6 inches above floor, unless otherwise noted on drawings. Those in finished spaces shall be set flush in walls and those on unfinished walls or where shown on drawings shall be set exposed. All cabinets shall be rigidly secured in place. All cabinets shall have fronts straight and plumb and arranged so that panelboards will be centered in door opening. Telephone cabinets over 30 inches wide shall have double doors.

Double-pole, 2 blade for 3 wire, single phase or 3 pole, 3 blade for 4 wire 3 phase, 250-volt switches with neutral connected to common busbar at top of panel will be acceptable for distribution panelboards when grounded neutral systems are installed.

The mains of panelboards shall be furnished with lugs only unless otherwise indicated.

4.16 SAFETY TYPE DISCONNECTING SWITCHES

Safety type disconnecting switches shall be Type A enclosed, 230 volt unless otherwise noted, rated in horsepower capable of interrupting the locked rotor current of the motor for which it is to be used, which current will be assumed six times the rated full load current.

4.18 FUSES

Protective devices for circuits not over 125 volts to ground and not over 30 ampere capacity shall be of the plug type and shall be of such a type and so designed as to be subject to tampering or bridging only with difficulty.

a. Fuses shall be one time, standard type, accurately rated, as made by ——— or approved equal.
b. Fuses shall be of the time delay type; capable of holding 200% load for 30 seconds; as made by ——— or aproved equal.

All other circuits shall be protected by cartridge fuses (one time, renewable)

a. Of standard type, accurately rated, as made by ——— or approved equal.
b. Time delay type, capable of holding 500% load for 10 seconds as made by ——— or approved equal.

All such fuses to bear the label of Underwriters' Laboratories, Inc. They shall be properly stored and protected until installed.

Spares amounting to one-half of a duplicate set of those installed shall be turned over to the owner upon completion of the building.

5.1 Feeders

5.11 RISER DIAGRAMS

Lighting and power feeders should be shown on a riser diagram giving the size of conduit, size and number of conductors and location of pull boxes, tapes and terminals.

A tabular listing of feeders giving the size of conduit, size and number of conductors and description of terminal points may be used instead of detailing this information on the riser diagram.

Feeders shall be run and connected as shown on the riser diagram. Conductor and raceway sizes shall be not less than as shown on the feeder schedule. Wherever practical, feeder conductors shall be continuous without splices between terminals. All conductors of a circuit shall be contained in the same raceway.

5.12 CARRYING CAPACITY

Every feeder and subfeeder should have a carrying capacity at least sufficient for the current corresponding to a maximum demand.

Compute the standard load for general illumination from the standard load in watts per sq. ft. and the area of the space served. Add to this load 1,000 watts for each circuit specified herein for purposes other than general illumination and 500 watts for each spare panelboard circuit, and any specific other load not otherwise included.

5.13 VOLTAGE DROP

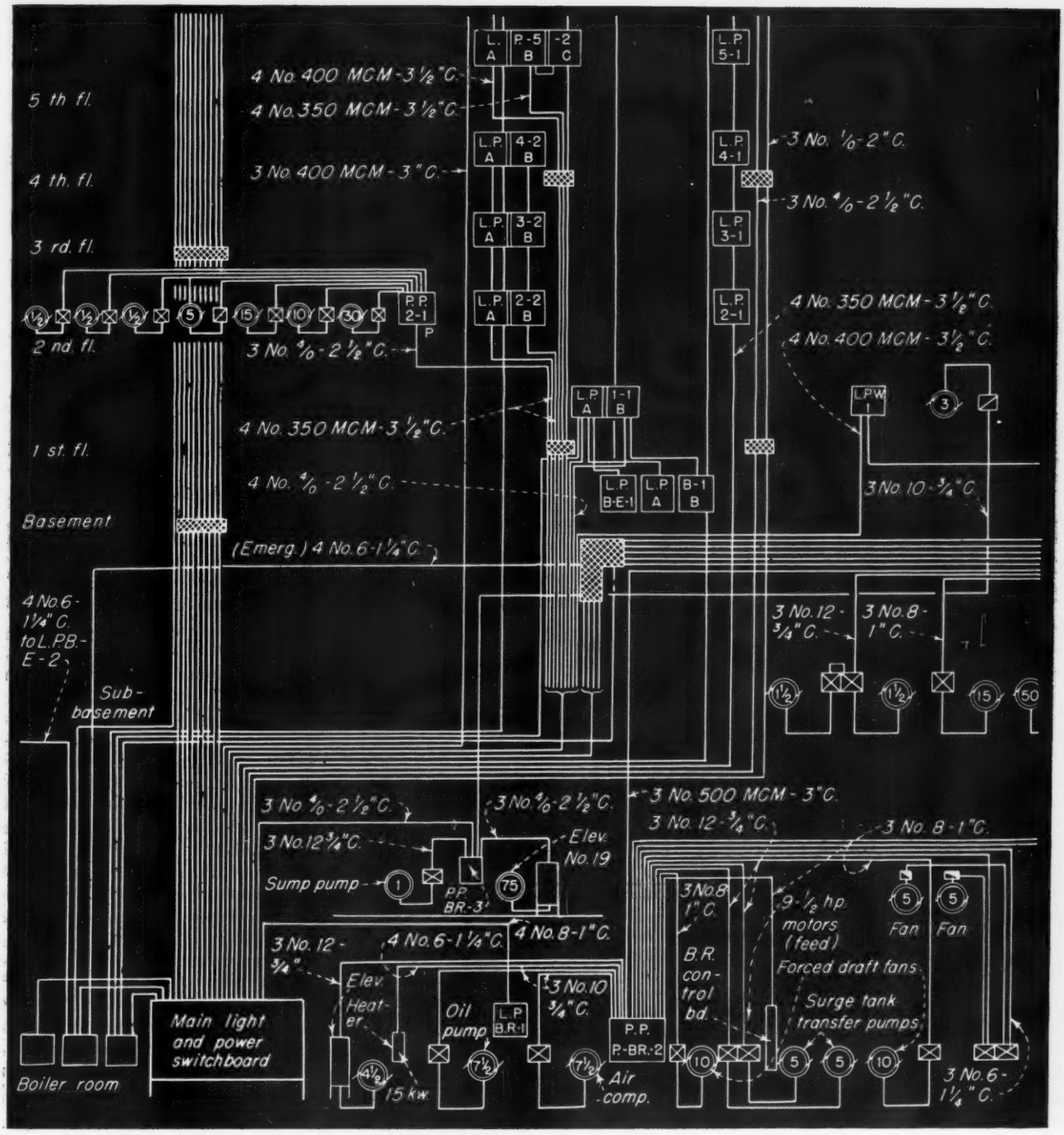
Feeders and subfeeders shall be of such size that, at a load corresponding to the maximum demand computed as stated above, the total voltage drop from the service entrance to any panelboard will not exceed 1.5 percent.

Provision should be made for a future increase in the capacity of the feeder system to provide for a load of 1,500 watts on each 15-amp. branch circuit installed so that, at such increased load, all feeders will have sufficient carrying capacity and the voltage drop will not exceed 1.5 percent.

Provisions for future capacity may be provided:

(1) By installing feeders of excess size as a part of the original installation. This method should be employed in every case where conductors not larger than No. 4 are required to meet the requirements for carrying capacity and voltage drop at the increased load.

(2) By installing oversize raceways, so that the conductors originally in-



Portion of a typical riser diagram.

stalled may be withdrawn at any time and replaced by conductors of suitable larger size.

(3) By making suitable provision so that additional feeders can be installed at a minimum of expense to provide the additional capacity.

Where either method (2) or method (3) is used, provision should be made at the feeder distribution center so that any larger feeders or new feeders installed can be properly controlled and protected without involving excessive expense for remodeling the original equipment.

Where method (3) is used, the system should be carefully designed so that the supplementary conductors can be used as separate feeders, not connected in multiple with the original conductors. Wherever these supplementary feeders must pass through walls, floors, or inaccessible places, suitable raceways should be installed when the original installation is made or work is in progress.

At feeder distribution centers, each feeder should be controlled and protected by a switch and fuses or by a circuit breaker.

5.14 CONDUITS

Conduits shall be (galvanized rigid steel, electrical metallic tubing, or other raceway) of approved type and manufacture. They shall be installed as shown on the plans and the riser diagram in an approved manner. Joints shall be set up tight. Hangers and fastenings shall be secure and of a type appropriate in design and dimensions for the particular application. Runs shall be straight and true; elbows, offsets and bends shall be uniform and symmetrical. Installation workmanship

shall be of the best quality and skill.

Couplings, connectors and fittings shall be approved types specifically designed and manufactured for the purpose. They shall be installed expertly to provide a firm mechanical assembly and electrical conductivity.

Wireways shall be an approved type and installed according to the recommendation of the manufacturer complete with the necessary fittings, connectors and parts.

All parts shall be of the same make and shall be assembled accurately and supported firmly. Standard sections and fittings shall be used wherever practical. Field cuts or alterations shall be made expertly in the manner prescribed by the manufacturer.

Armored Cable Feeders: Feeders shall be run in armored cable of approved type and manufacture. Sizes shall be as indicated on the feeder schedule. Cables shall be multi-conductor and the sheath shall enclose all conductors of the circuit. Splices shall be made in approved fittings or junction boxes. Fittings and connectors shall be made up tight to provide a firm mechanical connection.

Cables shall be strapped in place on girders and columns, following the structural members closely. Where cables cross open areas they shall be firmly supported by $\frac{3}{8}$ inch steel messenger wire in the manner detailed on the drawings.

CODE DEMAND FACTORS

Type of Occupancy	Unit Load Per Sq. Ft. (Watts)	Load to which Demand Factor Applies (Watts)	Demand Factor
Armories and Auditoriums	1	Total Wattage	100%
Banks	2	Total Wattage	100%
Barber Shops and Beauty Parlors	3	Total Wattage	100%
Churches	1	Total Wattage	100%
Clubs	2	Total Wattage	100%
Court Rooms	2	Total Wattage	100%
Dwellings—Single-Family	2	2,500 or less Over 2,500	100% 30%
Dwellings—Multi-Family other than Hotels)	2	3,000 or less Next 117,000 Over 120,000	100% 35% 25%
Garages—Commercial (storage)	½	Total Wattage	100%
Hospitals	2	50,000 or less Over 50,000	40%† 20%
Hotels, including apartment houses without provisions for cooking by tenants	2	20,000 or less Next 80,000 Over 100,000	50%† 40% 30%
Industrial Commercial (Loft) Buildings	2	Total Wattage	100%
Lodge Rooms	1½	Total Wattage	100%
Office Buildings	2	20,000 or less Over 20,000	100% 70%
Restaurants	2	Total Wattage	100%
Schools	3	15,000 or less Over 15,000	100% 50%
Stores	3	Total Wattage	100%
Warehouses, Storage	¼	12,500 or less Over 12,500	100% 50%
In any of above occupancies except single-family dwellings and individual apartments of multi-family dwellings:			
Assembly Halls and Auditoriums	1	Total Wattage as specified for the specific occupancy	
Halls, Corridors, Closets	½		
Storage Spaces	¼		

† For sub-feeders to areas in hospitals and hotels where entire lighting is likely to be used at one time; as in operating rooms, ballrooms, dining rooms, etc., a demand factor of 100 per cent shall be used.

5:15 WIRE AND CABLE

Wire and Cable: The selection of wires and cables is one of the most important in the specification of an electrical wiring system. The size and routing of the conductors determine the ultimate electrical capacity and energy distribution through the project. The quality of insulation determines its useful life.

Code tables designate the maximum safe carrying capacity of conductors based on size and type of insulation. Important economies can often be made by selecting insulations capable of withstanding higher temperatures such as RH.

On both feeder and branch circuits, voltage drop considerations often require larger conductors. Maximum permissible voltage drop should be determined and the losses allocated over the various parts of the system. A useful guide will be found on page 98.

As a general rule, liberal oversizing of wires to allow for future loads and the best quality of insulation provide ultimate values far beyond their small additional cost.

Furnish and install wires and cables of the size and numbers shown on the riser diagram. Insulation shall be (specify whether rubber or thermoplastics, and the Code designation; R, RH, RU or T). For wet locations insulation shall be (specify whether rubber or thermoplastic and Code designation; RW or TW, or lead covered). No wires smaller than No. 12 shall be installed unless specifically designated.

Wires shall be approved types of building wire manufactured since (month and year). They shall be suitably protected from weather or damage during storage and handling and shall be in first class condition when they are installed. Wires and cables shall be as made by ——— or equal as approved.

Raceways shall be complete before wires are installed.

Wires No. 6 and larger shall be connected to panels and apparatus by means of approved lugs or connectors. Connectors shall be solderless type, sufficiently large to enclose all strands of the conductor and securely fastened. They shall not loosen under vibration or normal strains.

Joints, taps and splices in wires larger than No. 6 shall be made by solderless connectors of an approved type and size. They shall be taped with electrical tapes providing insulation not less than that of conductor.

5.16 BUS FEEDERS

Furnish and install as shown on the plans an enclosed busbar feeder system of the type and capacity noted. System shall be as manufactured by the ——— company. (Specify the particular design, whether conventional or low reactance type, the type of insulation, the type of housing and special details of support or installation.) See also 6.51.

5.17 CABLE SUPPORTS AND BOXES

Cable supports and boxes shall be installed for all vertical feeders at intervals not less than the schedule in the National Electrical Code. The cable support shall be of the split wedge type which clamps each individual conductor firmly, and tightens due to weight of cable.

No splices or joints will be permitted in either feeders or branches except at outlets or accessible junction boxes. Joints in branch circuit wiring shall be made mechanically and electrically secure. Unless properly insulated by the connector, all joints shall be taped with electrical tape in a manner which shall make their insulation equal to the insulation of the conductors.

Conductors shall not be drawn into conduit until the plaster is dry and the conduit free from moisture. In drawing wires into conduits, allow sufficient slack or lead to permit the connections of fixtures, switches, etc., without additional splices.

5.18 UNDERGROUND DISTRIBUTION

Feeders and circuits installed underground require special considerations based upon the type of installation, soil conditions, possibility of damage and local practices.

Layout: Underground systems should be shown clearly on the plot plan. Runs should be direct and straight between manholes and terminal points, clear of roadways and separated from other underground systems particularly those requiring occasional maintenance or repairs.

Underground conduits: All conduits run underground shall be installed in (steel, fiber or asbestos-cement) conduits as specified or as indicated on drawings.

Conduits containing high voltage cables (over 600 volts) shall be installed not less than 30 inches below grade.

Trench shall be graded so that the conduits will have a fall of at least 3 inches in 100 feet towards the lower manholes or from the high point of the section towards the manholes or from building towards manhole.

All conduits containing high voltage cables shall be enclosed in concrete not less than 3 inches beyond any surface of the conduit. Separators shall be used to secure a uniform spacing between conduits of not less than 2 inches. Concrete shall be 1-3-4 mixture.

The concrete envelope shall be reinforced at all points where conduits cross fill or loose soil, or water, gas or sewerage mains. Reinforcement shall consist of one ½ inch reinforcing rod between each two ducts of bottom layer, and one rod laid at each lower corner of conduit envelope. Rods shall be laid parallel to conduits, centered between conduits and placed half way between bottom of conduit and bottom of concrete envelope. Reinforcing shall extend four feet beyond each end of fill or pipe main.

Fiber or asbestos-cement conduits shall be mandrelled to insure a smooth interior wall free from burrs or obstructions that will damage the cable. A No. 8 B and A galvanized steel drag wire shall be installed and left in all spare conduits not containing cables. All conduits shall be equipped with end bells where these conduits terminate in walls of building or manholes.

Manholes: Manholes shall be constructed of concrete with reinforced top and sides as indicated on drawings. Concrete shall be 1-2-4 mixture. Frames and covers shall be of cast iron, of sufficient strength for street loading and set to final grade as required. Provide pulling eye irons embedded in the opposite wall of each duct entrance to the manhole. Provide cable racks on walls spaced three feet on centers to accommodate the number of cables to be installed. End bells shall be provided in manholes for all conduit entrances. All manhole hardware shall be galvanized.

Each manhole shall have one driven ground rod, ¾ inch in diameter, 8 feet long, of hard drawn copper. The lead sheaths shall be grounded to ground rod.

6.1 Branch Circuits

Where individual branch circuits are extended to equipment they may supply any loads. If two or more outlets are served they may supply only the following loads.

a. 15 and 20 ampere branch circuits may serve lighting and appliances. The rating of any one appliance may not exceed 80 percent of the rating. The total rating of fixed appliances may not exceed 50 percent of the rating if other lighting or appliances are also supplied.

b. 30 ampere branch circuits may serve lighting in other than dwellings or appliances. The rating of any one appliance may not exceed 24 amperes.

c. 50 ampere branch circuits may serve lighting in other than dwellings, fixed cooking appliances, fixed range and water heater or infra-red lamp industrial heating appliances.

6.12 LIGHTING CIRCUITS

The minimum number of branch circuits required for general illumination should be based upon the standard loads.

For two-wire 15 amp. circuits, the load per circuit should not exceed 1,000 watts.

For multi-wire 15-amp. circuits, the load should not exceed 1,000 watts between each outside wire of the circuit and the neutral wire.

For heavy-duty circuits, the maximum load per circuit depends upon the smallest size of wire used in the circuit and should be 1,500 watts for No. 10 and 3,000 watts for No. 8 or No. 6.

No wire smaller than No. 12 shall be used for any branch circuit. If the single distance from the panelboard to the first outlet exceeds 50 ft. the minimum size of wire for this run shall be No. 10 and the minimum size between outlets shall be No. 12. Panelboards should be so located that no run from the panelboard to the first outlet will exceed 100 ft.; if in special cases this distance must be exceeded, the loads should be reduced or the wire sizes increased to provide for a voltage drop not exceeding 2 percent at the last outlet. This paragraph applies to both two-wire circuits and multi-wire circuits.

Show windows: Branch circuit wiring shall be installed to outlets for show window lighting, the circuit capacities to be based upon the wattage specified.

Case lighting: Branch circuit wiring shall be installed to outlets for show case and wall case lighting, the circuit

capacities to be based upon the wattage specified and the actual or probable lengths to be lighted.

No convenience outlets shall be supplied by any two-wire circuit, or by any outside wire of a multi-wave circuit, that supplies one or more outlets for general illumination, show window outlets for general illumination, show window lighting or case lighting. Outlets for show window spot or floodlighting and convenience outlets in or near the floor in show window spaces shall be controlled separately from the outlets for show window illumination called for.

No wire smaller than No. 12 shall be used for any circuit supplying convenience outlets. Runs exceeding 100 feet in length from the panelboard to the first outlet should be avoided wherever practicable, but if unavoidable, such runs shall be not smaller than No. 10 wire and the wire between outlets shall be not smaller than No. 12.

Wiring for motors and heating apparatus shall be installed in accordance with the accompanying wiring diagram.

If no detail diagram is used the following may be included in the specifications.

a. Each motor shall be supplied by an individual branch circuit from a distribution center. Conductors shall not be smaller than the minimum sizes permitted by the National Electrical Code and shall be of such size that the voltage drop from the distribution center to the motor will in no case exceed 1 percent when the motor is carrying its rated full load. Feeder conductors shall be of at least such size that the voltage drop from the service equipment to any distribution center will not exceed 3 percent when all motors are operating at their rated full load.

On exceptionally long motor circuits such as roof vent fans fed from basement panels the voltage drop of the circuit on the starting current of the motor should not be greater than 10 percent. A better practice is to feed such motors from nearby panels and operate by remote control circuits.

b. Motors shall be supplied through group subfeeders from distribution centers. Subfeeders shall either be brought direct to motor starters (or disconnecting means) or shall be connected to starters (or disconnecting means) by means of tap conductors. Subfeeders shall be of at least such size that when all motors are operating at full load the voltage drop from the distribution center to any motor starter will not exceed 2 percent. Feeders from service equipment to distribution centers shall be of at least such size that when all motors are operating at full load the voltage drop from the service equipment to any distribution center will not exceed 3 percent.

c. Motors shall be supplied by individual taps from the busbar distribution system. Taps or bus plugs shall be provided with (indicate whether disconnect switch, fuses, etc. as required). Circuit shall be extended from bus plug to controller in (conduit, flexible conduit, armored cable, heavy duty bus drop cable, etc.) not to exceed 25 feet in length.

6.14 BRANCH CIRCUITS, RESIDENTIAL

General purpose circuits (15 Ampere) shall supply all lighting outlets throughout the home and all convenience outlets except the convenience outlets in the dining room, breakfast room, kitchen, pantry, and laundry. These shall be provided on the basis of one circuit for not more than each 400 sq. ft. of floor area. Outlets supplied by these circuits shall be divided equally among the circuits.

Appliance circuits (20 ampere): Two 20-ampere circuits for the convenience outlets in the kitchen, pantry, breakfast room, dining room, and laundry in a residence having a floor area of 1,500 square feet or less. The wiring for such circuits to be so installed that outlets supplied from both circuits are available in both the kitchen and the laundry. For residences with a floor area greater than 1,500 square feet one 20-ampere circuit for the convenience outlets in the kitchen, pantry, breakfast room, and dining room; one 20-ampere circuit for the convenience outlets in the laundry; and one 20-ampere circuit supplying convenience outlets in both the kitchen and the laundry.

Item	Capacity
Range (up to 12 Kw)	35A-3W-115/230V
Range (above 12 Kw)	50A-3W-115/230V
Fuel Fired Heating Equipment (if installed)	15A or 20A-115V
Diswasher-Waste Disposer (if necessary plumbing is installed)	20A-2W-115V
Water heater	(Consult utility)
Automatic Washers	20A-2W-115V
Clothes Dryer	25A-3W-115/230V
Cooling Fan	20A-2W-115V
Air Cooling Unit	25A-2W-230V
Home Freeze Unit	20A-2W-115V
Bathroom Heater	20A-2W-115V or 230V
Work shop or bench	20A-2W-115V

The number of 20-ampere circuits required are necessary because appliances are available, of high wattage, and with automatic features that make possible the performance of several household tasks simultaneously. The use of 3-wire circuits for supplying convenience outlets in the locations mentioned is suggested as an economical means for dividing load and offering practical operating advantages.

6.15 METHODS OF WIRING

State which of the following approved wiring methods shall be followed. Detailed installation requirements for each of these wiring methods will be found in the National Electrical Code.

Approved wiring methods commonly employed for new construction are:

a. Rigid steel conduit
b. Electrical metallic tubing
c. Armored cable
d. Non-metallic sheath cable
e. Open and concealed porcelain protected (knob and tube)
f. Bus ways
g. Wireways
h. Underfloor duct
i. Cellular metal floors

Branch circuits shall be installed as shown on the floor plans. No wire smaller than No. 12 shall be used for any branch circuit unless otherwise noted on plans for special system circuits. Larger sizes shall be used where so indicated on the plans.

Outlets shall be located approximately as shown on the plans and shall be properly centered where located in panelled work or other special interior finish.

Wall switches shall be installed as shown on the plans and shall be connected to provide the control of outlets indicated on the plans.

Receptacles shall be the standard flush duplex type rated at 15 amp. and 125 volts, adapted to receive standard 2-prong plugs, or multi-outlet assemblies as noted on the plans.

The conductors terminating at each wired outlet shall be left not less than 8 in. long with their outlet fitting, to facilitate the installation of devices or fixtures. Where two or more pairs of conductors or circuits enter an outlet, the several pairs or circuits shall be neatly spliced and made mechanically and electrically secure to one or more single or multiple conductors, which conductors shall be not less than 8 in. long within the outlet.

Specify the type of wiring systems to be employed, the raceways, and

conductors and outlet boxes, indicating the quality, and any special feature of finish or grade. Choice of wiring systems is often limited in application by local ordinances and rules. Such rules should be considered.

6.21 CONDUIT

For all conduit work as called for elsewhere in these specifications furnish and install (select one or more types and state where each type shall be used:

a. Galvanized rigid steel conduit,
b. Corrosion resistive, non-ferrous alloy rigid conduit,
c. Flexible metallic conduit.

All conduit, elbows and couplings shall be as manufactured by ..... or equal.

6.22 EMT

For all electrical metallic tubing work as called for elsewhere in these specifications furnish and install approved tubing as manufactured by ..... or equal.

6.23 ARMORED CABLE

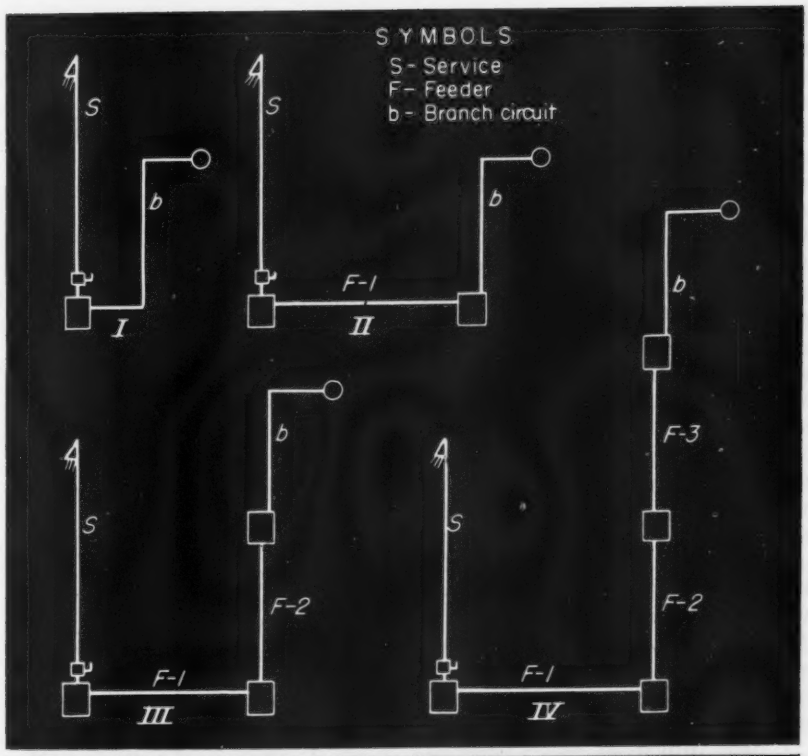
For all armored cable wiring as called for elsewhere in these specifications or shown on plans, furnish and install approved armored cable, properly bushed at ends and securely fastened to outlet boxes with approved connectors. Armored cable shall be of the best quality designed to offer a low resistance grounding path. Wires entering outlet boxes shall be not less than 8 inches long before stripping for joints or connections to devices. Armored cable shall be as manufactured by ..... or equal.

6.24 NON-METALLIC SHEATH

For all non-metallic sheathed cable wiring as called for elsewhere in these specifications furnish and install approved non-metallic sheath cable of the ..... type as manufactured by ..... or equal.

6.25 OPEN WIRING

For all open wiring or knob-and-tube work as called for elsewhere in these specifications, furnish and install non-combustible, non-absorptive insulating bushings, cleats, knobs and tubes as manufactured by ..... or equal, and flexible non-metallic tubing as manufactured by ..... or equal.



EXAMPLE	ALLOWANCES FOR VOLTAGE DROP										TOTAL DROP-SERV. TO OUT-120 V 2 W CIRCUIT	
	S SERVICE 3W 120/240V		F-1 FEEDER SECT. 1 3W 120/240V		F-2 FEEDER SECT. 2 3W 120/240V		F-3 FEEDER SECT. 3 3W 120/240V		b BRANCH CIRCUIT 120 V.			
	% OF 240V	VOLTS	% OF 240V	VOLTS	% OF 240V	VOLTS	% OF 240V	VOLTS	% OF 120V	VOLTS	% OF 120V	VOLTS
I	2.0	4.8	–	–	–	–	–	–	1.0	1.2	3.0	3.6
II	1.0	2.4	1.0	2.4	–	–	–	–	1.0	1.2	3.0	3.6
III	0.75	1.8	0.75	1.8	0.5	1.2	–	–	1.0	1.2	3.0	3.6
IV	0.5	1.2	0.5	1.2	0.5	1.2	0.5	1.2	1.0	1.2	3.0	3.6

Method of distributing voltage loss over the system.

6.26 BUSWAYS

Furnish and install the bus way system shown on the plan. The system shall be as manufactured by ..... or approved equal.

6.27 WIREWAYS

Furnish and install wireways as called for elsewhere in these specifications and as indicated on wiring plans, as manufactured by ..... or equal.

The cross-sectional area of wireways shall be .... in. by .... in. Covers and knockouts shall be provided in accordance with manufacturer's details.

6.28 UNDERFLOOR

Furnish and install the underfloor duct system as shown on the plans. Duct and fittings shall be as manufactured by ..... or approved equal.

6.29 CELLULAR FLOOR

Furnish and install all feeders and fittings for the cellular steel floor system shown on the plans. Cellular floor materials shall be as manufactured by ..... or approved equal.

6.31 BRANCH CIRCUIT CONDUITS

Conduits shall be of sizes required to accommodate the number of conductors in accordance with the tables given in the 1947 edition of National Electrical Code or as noted on drawings. The minimum size of conduit shall be .... inch. Joints shall be cut square, reamed smooth and drawn up tight.

Concealed conduits shall be run in as direct a line and with as long bends as possible. Exposed conduits shall be run parallel to or at right angles with the lines of the building, and all bends shall be made with standard conduit ells, conduit bent to not less

than the same radius or screw jointed conduit fittings, all bends shall be free from dents or flattening. Not more than the equivalent of four quarter bends shall be used in any run between terminals at cabinets, outlets, and junction or pull boxes. Boxes shall be located in accessible locations.

Conduits shall be continuous from outlet to outlet, and from outlets to cabinets, junction or pull boxes, and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from point of service to all outlets. Terminals of all conduits shall be furnished with locknuts and bushings. Plug the ends of each conduit with an approved cap or disc to prevent the entrance of foreign materials.

All terminals of electrical metallic tubing shall be provided with approved watertight fittings.

So far as practicable, all exposed conduits shall be run without traps. Where dips are unavoidable a pull box shall be placed at each low point or a hole drilled in under side of conduit, to provide means of escape for any moisture which may tend to collect in the conduit. Conduit systems shall be completed before conductors are drawn in. Where conduits must be run exposed, except as indicated in the plans, locations of the runs shall be subject to approval.

Considerations: On concealed conduit jobs exposed runs are usually installed where concealing would weaken structural features, slabs are too thin for the size of conduit required or in unfinished spaces.

6.32 OUTLET BOXES

Boxes for ceiling and interior bracket lighting fixtures shall have fixture studs. All studs shall be in centers of boxes and shall be strongly secured.

Boxes shall have only the holes necessary to accommodate the conduits at point of installation. All boxes shall have lugs or ears to secure covers.

Ceiling outlet boxes where conduit is concealed shall be not less than 4 inches in diameter by 1½ inches deep with plaster covers. Outlet boxes where conduit is exposed shall be screw jointed not less than 6 inches in diameter to provide a seat for fixture canopy. Where surface metal raceway is used outlets shall be of sufficient diameter to provide a seat for fixture canopy.

Outlet boxes for wall fixtures where conduit is concealed shall be deep type, 4 inches in diameter, and have covers with center opening 3 inches in diameter. Outlet boxes for bracket fixtures where conduit is exposed shall be screw jointed not less than 6 inches in diameter to provide a seat for fixture canopy.

Standard deep type concrete outlet boxes, shall be used where conduits enter sides in order to avoid steel reinforcing rods.

Outlet boxes for switches and plug receptacles in finished walls shall be of one piece standard gang boxes, 4 inches by 4 inches by 1½ inches deep for 1 device, 6⅞ inches by 4 inches by 1½ inches deep for 2 devices. They shall have covers with rectangular openings of proper size and shape. Outlet boxes for switches and plug receptacles on unfinished walls where same cannot be concealed shall be set exposed, unless otherwise noted on plans, and where exposed shall be screw jointed with covers to fit the device.

All boxes shall be rigidly secured in position. All boxes, except on unfinished ceilings and walls, except outlets for extensions, and except where conduit is run exposed shall be so set that the front edge of box shall be flush with finished wall or ceiling line or not more than one-fourth inch back of same. Bracket outlets shall be set 6 feet 6 inches from floor. When located on columns or over doors they shall be set symmetrical with columns or door.

Wall switch outlets 4 feet 6 inches above floor shall be set flush in walls. When located near doors or windows they shall be close to trim. Plug receptacles shall be 12 inches above finished floor unless otherwise noted and set flush in walls.

Wall switch outlets shown at door locations shall be installed on the lock side of the door.

Outlet boxes for telephone, signal, pushbutton and buzzer outlets shall be about 4 inches square and shall have covers with rectangular opening in center. Each such outlet shall have a plate with ⅜ inch bushed opening in center.

Telephone wall outlets shall be set flush in wall 12 inches above finished floor unless otherwise noted. Signal outlets shall be flush in wall 12 inches above floor or near ceiling, as indicated by symbol or noted on drawing.

Outlets for clocks over doors shall be set so that when clock is installed same will center between top of door trim and ceiling. When there is no door they shall be set about 8 feet 6 inches above the floor. These dimensions may be varied if desired to suit architectural conditions. Outlets shall have boxes, covers, single-plug receptacles and wall plates similar to those elsewhere specified for duplex receptacles except that receptacle shall be recessed so that when plug is inserted it will be flush and allow clock to hang covering outlet. Suitable hook shall be provided to support clock. Where the clocks are installed under the same contract as the electrical system, and the voltage for the clock wiring does not exceed 50 volts, or where clocks operate on three wires the receptacles at clock outlets may be omitted.

6.33 JUNCTION OR PULL BOXES

Junction or pull boxes not over 150 cubic inches in size shall be standard outlet boxes. Junction or pull boxes over 150 cubic inches in size shall be constructed same as cabinets, covers may be of same thickness as boxes and be secured by screws or bolts. All junction boxes shall be coated inside and out to prevent oxidation.

Junction boxes in main service conduits shall be ample size. All other junction boxes shall be not less than 4 inches square by 1½ inches deep. All junction boxes shall have closed covers and must be accessible after completion of the building. Junction boxes on concealed conduits shall be set with covers flush with finished plaster line, and on exposed conduits shall be set exposed, unless otherwise noted on drawings. Junction and pull boxes of sizes proportionate to the sizes of conduits or conductors served shall be installed where shown on drawings, and where necessary or convenient for installing the wires.

Floor boxes shall be of the watertight, adjustable type, arranged so that the top may be varied from the plane of its base. The boxes shall be approximately four inches in diameter by three and one-half inches deep. Each box shall be provided with a plug outlet or knockout as required. A gasket in a groove or an approved sealing cement shall be supplied between adjusting ring and body to make the box watertight.

Cover plates shall be of heavy brass with permanent ring or flange and rubber gasket. Brass cover plate shall have treaded hole approximately 1¾ inches in diameter, closed with flat plug in center. Covers shall be flush with the finished floor. For power outlets a receptacle shall be installed. All boxes shall be furnished with an outlet nozzle with bushed outlet, and threaded to fit hole in cover plate or other approved floor stand.

6.41 FLUSH DEVICES

Switches shall be flush tumbler type. They shall have a "T" rating of the Underwriters Laboratories, unless otherwise noted on the drawings. Switches controlling ceiling outlets totaling 300 watts or over shall be 20 ampere rating at 125 volts. Switches shall be single pole, double pole, three way or four way as indicated by symbol on plans. Switches located in public spaces shall be lock type, key operated. Where more than one switch is shown at a point, they shall be set under one plate in the appropriate order.

Mercury type flush switches: Switches shall be of the flush tumbler type designed for mounting in a standard outlet box. Switch shall have a hermetically sealed mercury button for making and breaking the circuit. They shall have a "T" rating of the Underwriters Laboratories, 5 amperes 125 and 250 volts. Single pole and double pole switches shall have "Off" and "On" indicating markings on the operating handle "on" in the up position.

Wall plates: Plates for each switch, receptacle, clock, signal and telephone outlet shall be (composition, brass, etc.).

Switches set in exposed screw jointed fittings or metal raceway for exposed wiring shall have plates to match the fitting and the edges of the plate shall be flush with the edges of the fitting.

Plug receptacles: Receptacles shall be flush type, 10 ampere, 250 volts except where otherwise noted on plans. All wall receptacles shall be duplex, and all floor box receptacles shall be of single type.

Combination fan hanger and receptacle: Provide a receptacle and hanger of suitable strength to support a 16-inch oscillating fan at all fan wall outlets. The receptacle shall be of standard type (single) and the hanger shall be secured to the outlet box by supports independent of the face plate or box cover. Outlet box shall be securely fastened in place. In all cases where conduit runs do not extend vertically through fan outlet provide a conduit nipple at least 12 inches long built into wall construction vertically and opposite the circuit conduit. Unless otherwise noted, fan outlets shall be 6 feet 10 inches from floor and shall be set to clear window trims or other obstructions by at least 12 inches.

Grounding receptacle: Receptacles for connection of groundable portable appliances shall be of the cord connector type with composition bodies, 3 pole, 20 ampere 250 volts, polarity-type, one pole for grounding.

6.45 RELAY SWITCH

Relay switching: As indicated on the plans, a remote control low voltage relay system shall be used for switching outlets, lights, appliances, receptacles and other equipment.

Furnish and install where shown a 24 volt current limiting type transformer of the capacity and type recommended by the manufacturer for the operation of relay switching systems.

Provide at each outlet or control point indicated a relay switch. Switch contacts and mechanism shall be approved for the load and service. Relay coil or coils shall be designed to position the switch contacts by momentary operation through (three wire positive on-off) (two wire sequence on-off) circuits.

Switches shall be momentary contact normally open and designed for the particular system and service. They shall be installed where shown in the manner recommended by the manufacturer.

Wiring shall be multi-conductor cable of the type designed for the system provided or recommended by the manufacturer and securely stapled in place.

6.51 BUSWAYS AND RACEWAYS

Furnish and install as shown on the plans an enclosed busbar distribution system of the capacity indicated. The system shall be complete with all fittings, enclosures, insulating and supporting members as shown. System and parts shall be of the same manufacture and designed to be used together. Assembly and installation shall be made according to the manufacturer's recommended practice. The system shall be as manufactured by ..... Company or equal.

Installation should be detailed on plans and all bus capacities, taps and fittings noted. Specifications may include gage of metal, dimensions of bars, type of insulation, facilities for tap connections, and methods of attachment to building.

Furnish and install bus plugs at locations shown on the plans. Bus plugs shall be of the type and size designated and shall be of the same manufacture as the bus system and designed for use with it. (Specify disconnect, over current protection, capacity and type of raceway or cable connection required).

When busways are used on ungrounded system a potentializer plug should be installed to establish a definite potential to ground.

6.61 MULTI-OUTLET ASSEMBLIES

At locations shown on plans furnish and install multi-outlet assembly in one or more continuous sections. These sections shall consist of an assembly having outlets to receive standard attachment plugs spaced ....in. apart. They shall be as manufactured by ..... Company or equal.

For window and cove lighting reflectors furnish and install assemblies of metal raceway or wireway containing lamp receptacles connected on circuits as indicated on wiring plans. They shall be as manufactured by ..... Company or equal.

Baseboard raceways: Furnish and install as called for elsewhere in these specifications and as indicated on the wiring plans a system of metallic baseboard wireways for (indicate whether single raceway for 115 volt service, single raceway for telephone and signalling service, or two parallel raceways forming two complete systems, one for 115 volt service and one for telephone and signalling service).

This system shall be installed complete with junction boxes, outlet fittings, cross-connected raceways, circuit conductors and wiring devices as indicated on plans. The system shall be as manufactured by.....Company or equal.

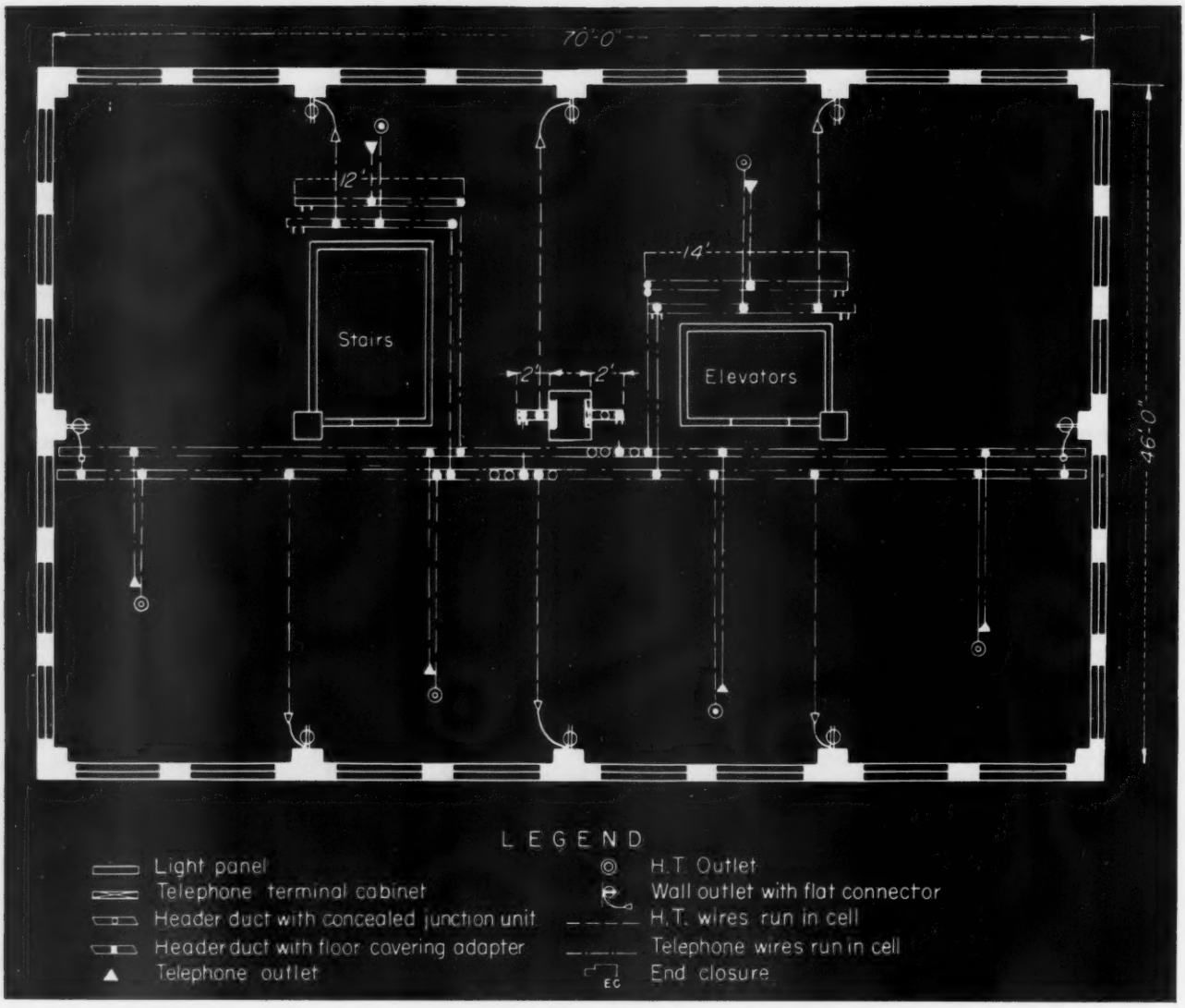
Busway with movable contacts: Furnish and install busways and fittings as detailed on electrical plans for mobile device operations. Each section of busway shall have a capacity of ..... amp., and the mobile devices shall make contact while in motion of not less than ..... amps. at any point along the length of busway. Mobile contact devices and busway shall be as manufactured by ..... Company or equal.

Cellular Steel Floor

Building construction (in the areas shown) consists of cellular steel floor of a type approved for use as raceways for electrical conductors.

Furnish and install all header ducts, end closures, feed connections, floor covering adapters, outlets, and taps as shown on the plans.

Cover plates, furnished by others, shall be brushed with cold flowing compound and attached to the floor by self tapping screws.



Typical cellular floor layout.

End closures shall be thoroughly sealed with tape and compound as recommended by the manufacturers.

Fittings and outlets shall be installed in an approved manner according to the practices recommended by the manufacturer.

Surface Raceways

Furnish and install where indicated on plans surface metal raceways as made by ..... Raceway, elbows, fittings and outlets shall be of the same manufacture and designed for use together. They shall be of a size approved for the number and size of wires installed. They shall be installed in an approved and workmanlike manner. Runs shall be parallel or at right angles to walls and partitions. Connections shall be made to other types of raceways in an approved manner with fittings manufactured for the purpose and application.

Underfloor Systems

Furnish and install the underfloor duct systems as shown on the drawings.

Furnish and install all junction boxes, fittings, connectors and outlets as shown. Raceways and parts shall be as made by the ..... company and shall be all of the same type and manufacture and designed for use together.

Installation shall be made according to the practices recommended by the manufacturer and the best workmanship. Surfaces of covers where intended to be flush with finished floor shall be level and true.

Outlets shown shall be installed and wired complete.

6.71 HAZARDOUS LOCATIONS

In areas indicated as hazardous or where required by the latest edition of the National Electrical Code, wiring shall be installed in accordance with the Code rules as they apply to hazardous areas. Materials shall be the best approved quality, specially designed and approved for the type of area and installation. Installation shall be made by mechanics thoroughly experienced in this type of work and workmanship shall be of the best quality and skill to assume the maximum safety.

6.81 EMERGENCY LIGHTING SYSTEMS

Emergency lighting systems are required by state laws, municipal ordinances, and by the National Electrical Code. While these requirements apply generally to theatres, moving picture shows, and other public gathering places, some states and cities have regulations which stipulate additional occupancies for which emergency lights

must be provided, such as hotels, schools, factories, etc.

A. Two or more independent sources of supply.

B. Auxiliary current supply:

1. Automatically charged batteries
2. Automatically started generators
3. Small non-compulsory emergency battery systems

Emergency lights must be kept lighted during definite periods of occupancy or building use, and in case of failure in the normal current supply, must be automatically transferred without appreciable delay to an emergency source of current. The emergency lighting system must be capable of lighting, for a specified period of normal current supply failure, all exit signs, and also provide sufficient illumination to enable persons to leave a building safely.

In many local or state regulations, the number, location and wattages of lighting outlets are prescribed, also the types and the ampere-hour or full-load capacity of auxiliary emergency systems are set forth, stating the minimum voltages that may be applied to standard lamps.

Specifications for equipment and wiring layouts for emergency lighting systems should therefore be checked in detail with the inspection authorities having jurisdiction.

A. Two independent sources:

Where two or more separate and complete systems with independent current supply can be installed, each of these systems may supply a part of the emergency lighting provided all emergency lights supplied on each independent current supply system are lighted. The several supply systems may also serve all or a part of the general house lighting system.

Unless all the emergency lights served by two or more independent supply systems are kept lighted, a throwover switch must be provided which will automatically transfer the emergency lighting system from the normal to the emergency service in case of current failure.

B. Auxiliary current supply:

B-1. Auxiliary storage batteries of approved type and capacity may be provided instead of, or in addition to, System A. These batteries must also be provided with an automatic throwover switch, and they must further be automatically maintained at a fixed minimum state of charge. These systems normally operate at 105 to 120 volts.

B-2. Auxiliary generators with prime movers may be used in lieu of B-1, provided they are equipped with automatic controllers, and are capable of generating the energy required for the full emergency load within a certain reasonable time limit after a current failure occurs.

a. Prime movers for driving auxiliary generators must be automatically started and may be

a-1. internal combustion engines,

a-2. steam driven engines,

a-3. steam or water driven turbines.

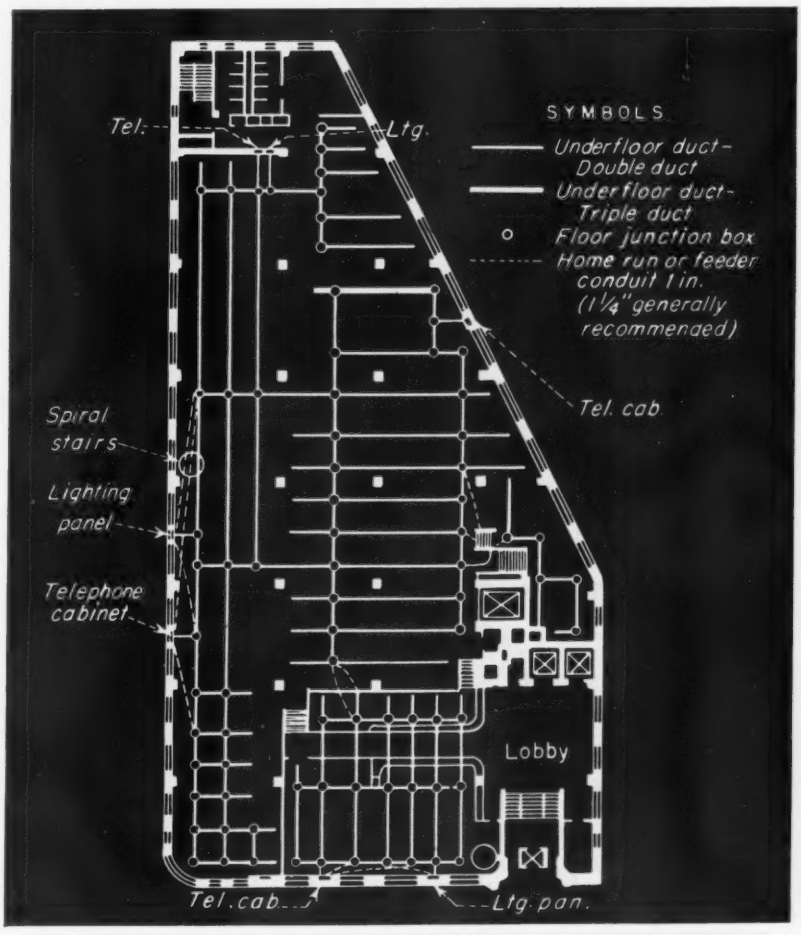
b. Automatic controllers must include approved storage batteries of the correct capacity for necessary cranking of the foregoing types of engines, or for operating the engine supply valves, as the case may be. When cranking batteries are employed, approved automatic charging devices must be provided for them. These generators commonly operate at 110 to 115 volts.

c. Automatic throwover switches, as called for in System A must also be provided for System B-2.

d. Auxiliary generators are sometimes permitted to be installed with sufficient capacity to supply all or part of the general lighting system, as well as the emergency lighting outlets prescribed by regulations.

B-1 and B-2. Approved warning or derangement signal devices of the audible or visual types must be provided for systems B-1 and B-2. These signals shall automatically give warning of a derangement of the emergency current sources, and shall indicate when batteries or a generator set are carrying the emergency illumination load.

B-3. Small emergency lighting systems are used voluntarily in banks, stores, factories and other places that are not required to provide emergency lighting systems. These systems are designed to supply through a storage battery a small number of specially equipped lighting units located in several important areas. A separate circuit is run from an automatic battery control panel to these lighting units. This circuit has no electrical connection with other normally supplied circuits. The automatic control panel usually consists of an automatic battery charging device and an automatic switch or relay for turning on the auxiliary lighting circuit whenever there is a failure in normal energy supply. A power supply connection must be provided between the control panel and the normal supply system for the throwover relay and for the automatic battery charger.



Typical underfloor system layout.

These systems usually operate at from 10 to 32 volts. Wiring must be designed for low voltage loss.

Installation

a. All conductors for systems A, B-1 and B-2 are required to be installed in metal raceways or armored cable. No conductors of other feeders or branch circuit wiring shall be installed in the same raceways, outlet boxes, wireways or cabinets supplying the emergency lighting systems.

b. The service equipment for emergency lighting systems must be so connected that it will not be interrupted by the disconnecting of normal service equipment devices or by the functioning of normal service equipment over-current devices, except for the momentary delay while automatic throwover devices are functioning. Only the emergency service over-current devices shall be placed ahead of the emergency branch circuit over-current protective devices.

c. The switch for turning emergency lighting circuits "on" or "off" at the opening or closing of a theatre or other occupancy must, except as provided in paragraph d, be limited to one switch accessible only to authorized persons. This switch should preferably be located in the lobby or other place convenient to the main entrance of the building. This requirement will usually necessitate the installation of an emergency lighting panelboard that contains a remote-controlled master switch. A remote-control switch designed to operate this master switch can thus be placed in the lobby to meet the foregoing requirement. When the emergency lighting system only requires one to three branch circuits, a single or multipole switch can be provided in the lobby for directly controlling the several circuits. A feeder control switch for manually switching a group of emergency circuits from the lobby is not recommended, and in most cases requires a considerable increase in the length of the feeder conductors and raceway.

d. It is permissible to provide a separate switch for controlling one or more circuits supplying exterior lights.

System B-3 may involve runs of considerable length to scattered outlets. When low voltage auxiliary batteries are used, the conductors should be of adequate size to avoid excessive voltage losses and to prevent a corresponding reduction of illumination intensity. See Conductor Size table at left below.

CONDUCTOR SIZE

Length of Circuit (Oneway)	Load in Amperes						
Feet	1	2	4	6	7	8	10
SIZE WIRE ON 12 VOLT SYSTEM—AWG							
50	18	18	16	16	16	14	14
75	18	18	16	14	14	12	12
100	18	18	14	12	12	12	10
150	18	16	12	12	10	10	8
200	18	14	12	10	10	8	8
400	14	12	8	6	6	6	5
600	12	10	6	6	5	4	3
800	12	8	6	4	4	3	2
1000	10	8	5	3	3	2	1
SIZE WIRE ON 24 VOLT SYSTEM—AWG							
50	18	18	18	18	18	18	16
75	18	18	18	18	16	16	14
100	18	18	18	16	16	14	14
150	18	18	16	14	14	14	12
200	18	18	14	12	12	12	10
400	18	14	12	10	10	8	8
600	16	12	10	8	8	6	6
800	14	12	8	6	6	6	5
1000	14	10	8	6	6	5	4

Conductor sizes for low voltage systems.

6.82 STORAGE BATTERY SYSTEM

Furnish and install, in satisfactory operation, a complete emergency unit as indicated on the drawings. This unit shall consist of a storage battery, of a capacity sufficient for carrying the total emergency load for a period of two hours, a control panel for the storage battery arranged for operation in connection with current available at the building, and a suitable means for charging and maintaining the battery in a fully charged condition.

Storage battery: The storage battery shall consist of 60 cells, and shall be able to deliver amperes required for a period of two hours, when fully charged, to a final voltage of not less than 105 volts across the battery terminals.

Control cabinet: An automatic control cabinet shall be furnished. There shall be mounted in this cabinet a double pole automatic switch which will transfer the emergency circuit from the normal supply to the battery circuit upon failure of the normal supply and automatically will reconnect the emergency circuit to the normal supply when the service is restored. This automatic switch shall have a safe carrying capacity for the total connected load. It shall be so mounted that it will be accessible for the replacement of any parts or for making any adjustments.

On the face of the cabinet there shall be mounted a voltmeter, a milliammeter to read the charge rate and a switch for control of the emergency circuit.

Circuit protection shall be provided for protection of the normal supply circuit, and the charging device of the same type as specified for panelboards.

A rectifier, capable of charging the 60 cell storage battery described above, in one series, shall be mounted in the cabinet in such a way that it will be accessible. It shall be designed for the current available and shall be capable of charging the battery at an approximately average rate of 4.6 amperes. This charger, when connected through proper resistance which shall be provided in the cabinet, shall be capable of trickle charging the battery at the proper rate, all equipment shall be left in operating condition.

Copies of instructions describing in detail the maintenance, care and operation of the equipment shall be furnished.

7.1 Signal, Communication and Auxiliary Systems

7.12 RADIO AND TELEVISION ANTENNA SYSTEMS

A. Radio, small installations. (1 to 25 sets)
B. Radio large installations. (25 or more sets)
C. Television, multicoupler.
D. Television, amplified.

General

Furnish and install a (trade name and/or number) radio (or television) antenna system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left completely equipped and in first class operating condition.

Description

A. Radio antenna system for small installations: Install a doublet antenna of the required length of stranded copper or bronze wire with insulators, coupling transformer, lightning arrestor, lead-in, down-lead, ground wire and guy wires. This antenna shall be supported on poles (or masts) and thoroughly braced. It shall clear the roof by at least 15 feet. Outlets shall be installed at locations shown on plans.

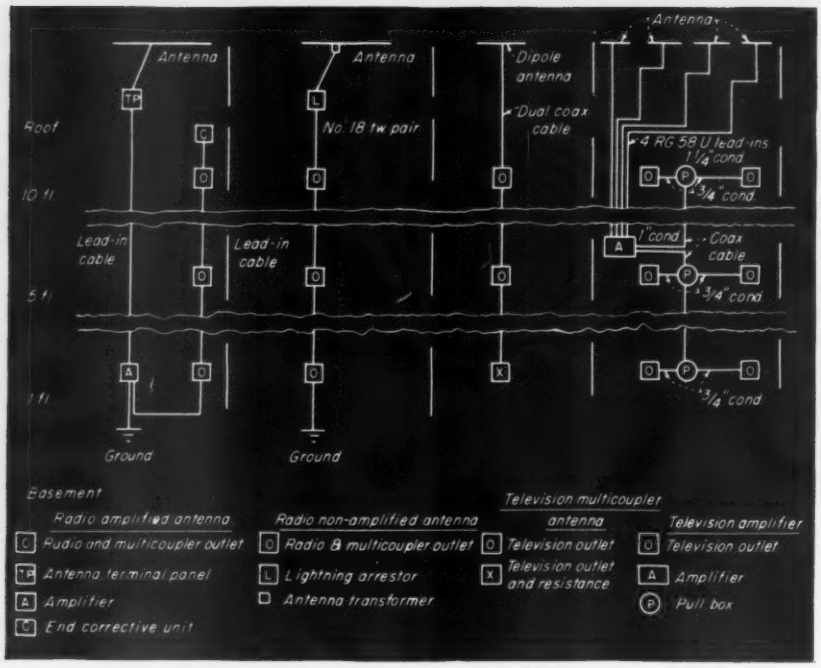
B. Radio antenna system for large installations: Install a doublet antenna of the required length of stranded copper or bronze wire with insulators, amplifier and set couplers, lightning arrestor, lead-in, down-lead, ground wire, guy wires, terminal panel and corrective units. This antenna shall be supported on poles (or masts) and thoroughly braced. It shall clear the roof by at least 30 feet. Outlets shall be installed at locations shown on plans.

C. Television antenna system, multicoupler non-amplified: Install a dipole antenna of the required type with down-lead coaxial cable, riser coaxial cable, multicoupler outlets, terminal resistors and ground wire. This antenna shall be properly supported and braced. It shall clear the roof by 15 feet. Outlets shall be installed at locations shown on plans. Gounding of the support shall be made to the nearest cold water pipe.

D. Television antenna system, amplified: Install one or more dipole antenna of the required type with down-lead coaxial cable, riser coaxial cable, booster amplifier, set outlets and

SIGNAL SYSTEMS PROSPECTS

Type System	Apartments	Bank	Bowling Alley	Church	Court House	Department Store	Dormitory	Estate	Home—Aged	Hospital	Hotel	Industrial	Mansion	Mortuary	Museum	Office Building	Prison	Public Building	Residence	School	Small Store	Theatre	Warehouse
Burglar Alarm		x			x	x		x				x	x		x	x			x		x		x
Call Systems		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				x	x
Clocks		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		x	x
Door	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x
Fire Alarm Automatic							x	x	x	x	x	x	x		x		x	x	x				x
Fire Alarm Manual		x			x	x	x	x	x	x	x	x	x		x	x	x	x		x		x	x
Hold-Up Alarm		x				x					x							x				x	
In and Out		x						x	x	x			x			x							
Interphones	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x	x
Nurses Call									x	x		x					x						
Paging—Audible						x						x											x
Paging—Silent		x				x		x		x					x			x				x	
Paging—Voice						x				x	x	x											
Program						x	x					x			x		x			x			x
Psychiatric										x													
Sprinkler Alarm						x		x			x	x				x	x	x					x
Sound Systems				x		x	x	x	x	x	x	x	x		x		x			x		x	
Tank Alarm	x							x	x			x			x	x	x	x				x	x
Watchmans Tour		x			x	x	x	x	x	x	x	x			x	x	x	x					x



Riser layout radio and television antenna systems.

ground wire. The antenna or antennas shall be properly supported and braced. It shall clear the roof by at least 15 feet and be arranged so that if more than one is used there will be no interference between antennas. Grounding of the support shall be made to the nearest cold water pipe.

Equipment

Aa. Install in each suite where shown a radio and multicoupler outlet on two-gang metal (or plastic) plate for connecting the set to the antenna and to power.

Ab. Install where shown on the riser layout an Underwriters approved lightning arrestor.

Ac. Install where shown on roof a complete antenna consisting of two sections stranded copper or bronze conductor insulated from each other. The length shall be as recommended by the manufacturer. The down-lead shall be connected to an antenna transformer and carried in conduit within the building.

Ba. (Same as paragraph Aa.)

Bb. (Same as paragraph Ab.)

Bc. Install where shown on roof a complete antenna consisting of two or more sections stranded copper or bronze conductor insulated from one another. The length shall be as recommended by the manufacturer. The down-lead shall be connected from the antenna to a tube amplifier and carried in conduit within the building. Connect dead-end corrective unit at end of run.

Ca. Install in each suite where shown a television set outlet on two-gang metal (or plastic) plate for connecting the set to the antenna and to power. At the end of the riser dual coaxial cable the set outlet shall contain a terminal resistor unit.

Cb. Install where shown on roof a complete dipole antenna of the all-channel, broad band and high gain type and connect to the dual coaxial cable. The down-lead shall be carried in conduit within the building. A terminal resistor unit shall be connected at the end of each riser.

Da. Install in each suite where shown a television set outlet on two-gang metal (or plastic) plate for connecting the set to the antenna and to power.

Db. Install a pre-tuned booster amplifier where shown near roof in surface steel cabinet with ventilated door equipped with lock and keys. A time switch shall also be provided to automatically connect and disconnect the amplifier.

Dc. Install where shown on roof one or more (depending on number of channels) directional antennas of the broad band and high gain type and connect to the dual coaxial cable. The down-lead shall be carried in conduit within the building.

Operating Current

All power outlets for sets shall be connected to the lighting system in the suites. Amplifiers shall be connected to separate circuit from nearest lighting panel supplying current to the building proper.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The lead-in or down-lead wires for (radio shall be No. 18 twisted pair) (television shall be coaxial cable of the size and type as recommended by the manufacturer of the antenna system). Wires for ground connection shall be as recommended by the manufacturer of the antenna system. Coaxial cable shall be run from the antenna (or amplifier) and looped through each television outlet in accordance with the riser diagram.

7.13 INTERCOMMUNICATING TELEPHONE SYSTEMS

A. Two station.
B. Common ringing and common talking.
C. Master selective ringing and common talking.
D. Selective ringing and common talking.
E. Selective ringing and selective talking.
F. Private exchange, manual switchboard.
G. Private exchange, automatic switching.
H. Apartment selective ringing and common talking, vestibule to suites, suites to door-opener. (1) loudspeaking, (2) non-loudspeaking.
I. Apartment selective ringing and common talking, vestibule to suites, suites to door-opener, suites to superintendent. (1) loudspeaking, (2) non-loudspeaking, (3) Superintendent non-selective, (4) superintendent selective.
J. Apartment selective ringing and common talking, vestibule to suites, suites to door-opener, suites to superintendent, tradesmen to suites. (1) loudspeaking, (2) non-loudspeaking, (3) superintendent non-selective, (4) superintendent selective.

General

Furnish and install an (trade name and/or number) intercommunicating telephone system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

Operation

A. Two station system: At the two locations shown there shall be a tele-

phone arranged so that one station may call and converse with the other. A pushbutton shall be provided with each unit. Pressing the button at one station shall ring the bell at the other station. Lifting the handphone (or receiver) completes the talking circuit.

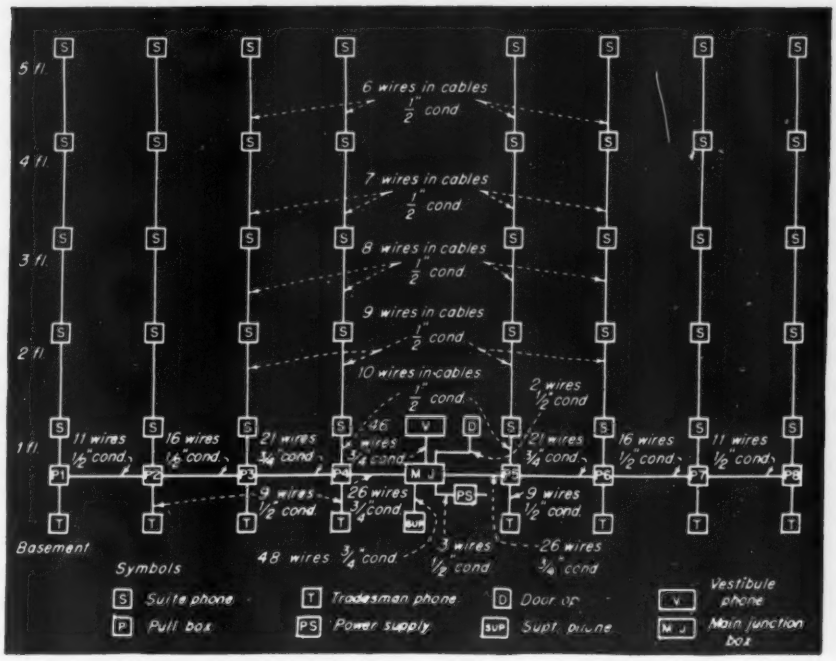
B. Common ringing and common talking system: At each location shown there shall be a telephone arranged so that any station may call all others simultaneously. A pushbutton shall be provided with each unit. Pressing the button of one station rings the bells in all other stations. A series of codes is used to distinguish different calls. The called person may answer at any station. Lifting the handphone (or receiver) completes the talking circuit.

C. Master selective ringing and common talking: In the main office where shown there shall be a master telephone with pushbuttons (or selector switch) to selectively call any outlying telephone. At other locations the telephone shall have a pushbutton (or selector switch) to call the master station. The master station after being called by an outlying station may call another outlying station to complete a connection between the two remote points. Only one conversation at a time is required.

D. Selective ringing and common talking system: At each location shown there shall be a telephone arranged for calling and conversing with any other telephone in the system. Each station shall be provided with pushbuttons (or selector switch) for selectively ringing any other station. Only one conversation at a time is required.

E. Selective ringing and selective talking system: At each location shown there shall be a telephone arranged for calling and conversing with any other telephone in the system. Each station shall be provided with pushbuttons (or selector switch) for selectively ringing and selectively talking with any other station in the system. It shall be possible to use all telephones simultaneously provided that the called station is not pre-occupied.

F. Private exchange, manual switchboard system: In the switchboard operator's room there shall be a common return, lamp signal type manual switchboard arranged to call and interconnect any telephone in the system. At other locations where shown there shall be a telephone of the type designated by the symbol. The telephone operator may call and converse with any outlying station, and any outlying station may call and converse with the operator, or be connected through the switchboard so that two outlying telephones may converse. Removing the handphone (or receiver) on any outlying station will cause its associated lamp to light at the switchboard. Connection from one line to another may be made by inserting the plugs of the cross-connecting cords into the calling and called station line jacks. Operator listens and converses through a headset and breast-plate transmitter connecting into individual cross-connecting sets by means of listening and ringing keys. Each set of cross-connecting cords shall be provided with supervisory lamps to indicate completion of a conversation between two stations. A buzzer and switch shall be provided on the switchboard as a night signal.



Riser layout for apartment telephone system.

G. Private exchange, automatic switching system: In the machine room in basement there shall be a complete automatic exchange unit. This shall consist of an automatic relay (or step-by-step) switching unit, cable distribution rack, rectifiers, control panel and battery with rack. At other locations where shown there shall be an automatic dial type telephone of the type designated by symbol. The system shall enable any station in the system to call and converse with any other station without the assistance of an operator. Lifting a handphone (or a receiver) on the calling station and dialing the desired number shall automatically ring the called station. The talking circuit is completed when the handphone (or receiver) is lifted at the called station. A busy signal shall be audible in the handphone (or receiver) of the calling station when the called station lines are pre-occupied.

H. Apartment selective ringing and common talking system, vestibule to suites, suites to door-opener: In each tenant's suite there shall be a telephone. A pushbutton shall be provided thereon to operate the door-opener at the main entrance. In the vestibule there shall be a telephone and plate with pushbuttons and cardholders for every suite in the building. Pressing a pushbutton thereon will cause a bell to ring in the corresponding suite telephone. Only one conversation is required at one time. Provide a buzzer in each suite telephone to operate from a pushbutton at the entrance to the suite. Provide government approved mailboxes for each suite and gang them with the vestibule telephone unit.

I. Apartment selective ringing and common talking system, vestibule to suites, suites to door-opener, suites to superintendent: In each tenant's suite there shall be a telephone. Two pushbuttons shall be provided thereon, one for the door-opener at the main entrance, the other for (3) operating the bell in the superintendent's telephone, (4) operating a drop and ringing a bell in the superintendent's telephone annunciator. In the vestibule there shall be a telephone and plate with pushbuttons and cardholders for every suite in the building. Pressing a pushbutton thereon will cause a bell to ring in the corresponding suite telephone. Only one conversation is required at one time. Provide a buzzer in each suite telephone to operate from a pushbutton at the entrance to the suite.

Provide government approved mailboxes for each suite and gang them with the vestibule telephone unit.

J. Apartment selective ringing and common talking system, vestibule to suites, suites to door-opener, suites to superintendent, tradesmen to suites. In each tenant's suite there shall be a telephone. Two pushbuttons shall be provided thereon, one for the door-opener at the main entrance, the other for operating the bell in the superintendent's telephone, (4) operating a drop and ringing a bell in the superintendent's telephone annunciator. In the vestibule there shall be a telephone and plate with pushbuttons and cardholders for every suite in the building. Pressing a pushbutton thereon will cause a bell to ring in the corresponding suite telephone. In the basement adjacent to each dumbwaiter there shall be a telephone having pushbuttons and cardholders for every suite served by the dumbwaiters. Pressing a pushbutton thereon will cause the bell to ring in the corresponding suite telephone. Only one conversation is required at one time. Provide a buzzer in each suite telephone to operate from a pushbutton at the entrance to the suite. Provide government approved mailboxes for each suite and gang them with the vestibule telephone unit.

Equipment

Aa. Install at each location in office a handphone on cradle type desk (or flush or surface wall mounting with handphone or with watchcase receiver and built-in transmitter) telephone having mounted thereon a pushbutton for calling the other telephone on the system. (Provide desk unit with 6 feet flexible cable, terminal strip box and buzzer signal; others with bell signal)

Ba. Install at each location where shown a handphone on cradle type desk (or flush or surface wall mounting with handphone or with watch case receiver and built-in transmitter) telephone having mounted thereon a pushbutton for calling all other telephones simultaneously. (Provide desk unit with 6 feet flexible cable, terminal strip box and buzzer signal; others with bell signal)

Bb. Install in or near power supply a retardation coil and connect to telephone system.

Ca. Install in office where shown a master handphone on cradle desk (or flush or surface wall mounting with handphone or with watchcase receiver and built-in transmitter) telephone having mounted thereon—pushbuttons (or selector switch with—points) to call all outlying stations. At all other locations install the type of telephone indicated by symbol having mounted thereon one pushbutton (or selector switch with one point) to call master station. (Provide desk unit with 6 feet flexible cable, terminal strip box and buzzer signal; others with bell signal)

Cb. (same as paragraph Bb.)

Da. Install at each location where shown a handphone on cradle desk (or flush or surface wall mounting with handphone or with watchcase receiver and built-in transmitter) telephone having mounted thereon—pushbuttons (or selector switch with—points) to call any other telephone in the system. (provide desk unit with 6 feet flexible cable, terminal strip box and buzzer signal; others with bell signal)

Db. (same as paragraph Bb.)

Ea. Install at each location where shown a handphone on cradle desk (or flush or surface wall mounting with handphone) telephone having mounted thereon—locking pushbuttons (or reset selector switch with—points) to call any other telephone in the system. (Provide desk unit with 6 feet flexible cable, terminal strip box and buzzer signal; others bell signal)

Fa. Install at each location where shown a handphone on cradle desk (or flush or surface mounting with handphone or with watchcase receiver and built-in transmitter) telephone. (Provide desk unit with 6 feet flexible cable, terminal strip box and buzzer signal; other with bell signal)

Fb. Install in telephone switchboard room a free-standing (or turret or desk type) common return, lamp signal, manual telephone switchboard. This unit shall be equipped for—line and lamp jacks (for all stations plus 10 percent) or nearest largest standard switchboard manufactured,—cross-connecting cords and ringing and listening keys, (based on 5 for first 50 lines plus 1 for each 10 additional lines) buzzer and switch, headset and breastplate transmitter with cord and plug, line terminals in rear. The cross-connecting cords shall be complete with supervisory pilot lamps.

Ga. Install at each location where shown a handphone on cradle desk (or flush or surface wall mounting with handphone) telephone with automatic dial and ringer. (Provide desk unit with 6 feet flexible cable and terminal block)

Gb. Install in machine room a complete automatic exchange unit. The machine switching equipment shall be fully equipped for—lines plus 25 percent space for future expansion, including switching and rack facilities, ringing apparatus, rectifier equipment, battery and rack.

Ha. Install in each suite a flush (or surface) wall type telephone provided with one pushbutton and cardholder. (1) a talk and answer speaker mounted behind grille front with press-to-talk button, (2) a watchcase receiver and built-in transmitter and hook-switch, (1, 2) together with necessary terminals and backbox.

Hb. Install in vestibule a (1, 2) loudspeaking telephone, (2) nonloudspeaking telephone with armored cord receiver and built-in transmitter, (1, 2) with ——— pushbuttons and cardholders (one for each suite) and flush louvred lamp for illuminating plate. Outer frame shall be designed to contain government approved mailboxes. Backbox to be provided for the telephone in vestibule.

Hc. Install a mortise type door-opener in main entrance door frame and fasten securely in place, and even with door lock.

Ia. Install in each suite a flush (or surface) wall type telephone provided with two pushbuttons and cardholders. (1) a talk and answer speaker mounted behind grille front with press-to-talk button, (2) a watchcase receiver and built-in transmitter and hook-switch, (1, 2) together with necessary terminals and backbox.

Ib. (same as paragraph Hb.)

Ic. Install in superintendent's suite a flush or (surface) (3) wall mounting telephone with 1 pushbutton for door-opener, (4) wall mounting telephone annunciator with complete telephone and annunciator with ——— electric reset drops (one for each suite) and one reset pushbutton for each 10 drops and one pushbutton for door-opener, (1, 2) complete with necessary terminals and backbox.

Id. (same as paragraph Hc.)

Ja. (same as paragraph Ia.)

Jb. (same as paragraph Hb.)

Jc. (same as paragraph Ic.)

Jd. Install at each dumbwaiter a surface wall mounting telephone with ——— pushbuttons and cardholders (one for each suite served) and provided with watchcase receiver and built-in transmitter.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors, plus ten percent spares. Terminal strips must be mounted on a sheet of insulating material.

Operating Current

The system shall operate from a dry plate rectifier power supply cabi-

net with a capacity of sufficient size to carry the load of the system. This unit shall have an input of 115 volts 60 cycle a-c derived from a separate circuit from the nearest lighting panel. (G)a float-on-line dry plate rectifier charger and a storage battery, the rectifier to be capable of a booster charge if required.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wire shall be color-coded and in general shall be standard heavy braided type, except in damp locations (or underground where it shall be lead-covered.) (A, B) twisted pair No. 19 B & S gauge, (C, D, E, H, I, J) cable with 2 pair No. 18 B & S gauge, balance single or paired No. 22 B & S gauge, (F, G) cable with pairs No. 22 B & S gauge, branches twisted duplex or triplex No. 19 B & S gauge.

Finish

Finish on instruments shall be standard insofar as possible except annunciators and manual switchboards which shall be as approved by the Architect.

7.14 SOUND SYSTEMS

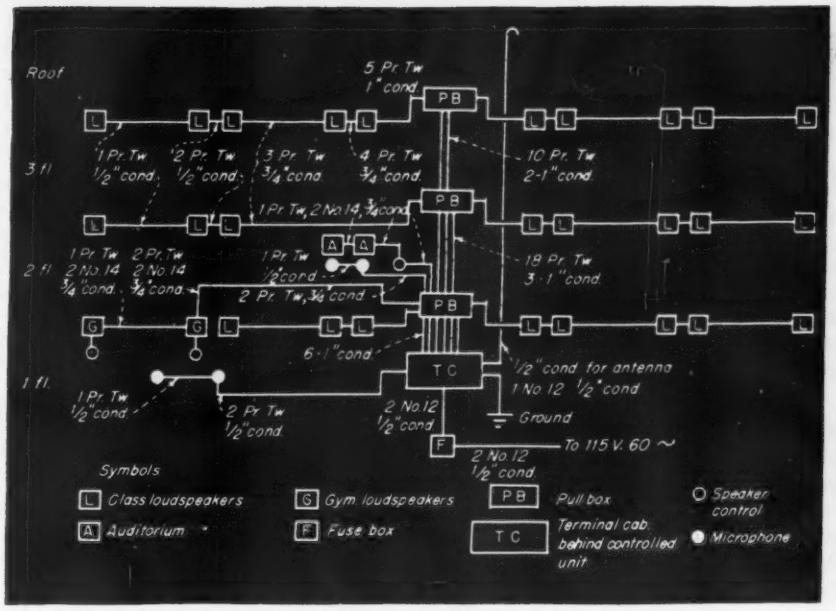
A. Single-channel.
B. Multi-channel.
C. Intercommunication, two station.
D. Intercommunication, master selective ringing, common talking.
E. Intercommunication, selective ringing, common talking.
F. Intercommunication, selective ringing, selective talking.

General

Furnish and install a (trade name and/or number) sound channel (or sound intercommunication) system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

Operation

A. Single-channel sound system: Install a single channel sound distribution system providing facilities for the distribution of a radio, phonograph or microphone program to any individual, selected group or all loudspeakers in the system. Install in a free-standing cabinet where shown in special room, complete receiving and distribution equipment and a microphone. It shall be possible to supervise rooms by means of a monitoring loudspeaker and to carry on a two-way conversation with an outlying station by operating a "talk-listen" switch and talking into the microphone. Install additional microphones in principal's office and on stage in auditorium. Install in each classroom a loudspeaker of the permanent magnet dynamic type. Install in the auditorium two high fidelity dynamic loudspeakers with directional horns mounted behind grille, one on each side of the stage, and provide with volume control.



Riser layout school sound system.

B. Multi-channel sound system: (Similar to paragraph A. except for additional radio and distribution equipment for two or more channels)

C. Intercommunication, two-way sound system: At the two locations shown on plans there shall be a sound intercommunicator arranged so that one station may call and converse with the other. A "press-to-talk" switch shall connect the speaker-microphone so that the calling station may converse with the called station. A separate key or switch shall be used for signaling the called station.

D. Intercommunication, master selective ringing, common talking system: In the manager's office there shall be a sound intercommunicator of the master type arranged so that any outlying station may be called individually or for conference by operating an individual or all calling buttons. By operating the "press-to-talk" switch the speaker-microphone is connected to any or all outlying stations. The outlying stations have a calling button to call the master station and a "press-to-talk" switch for conversing.

E. Intercommunication, selective ringing, common talking system: In each office where shown on plans there shall be a sound intercommunicator of the multiple type arranged so that any station may call and converse with any other station in the system. A "press-to-talk" switch shall connect the speaker-microphone so that the calling station may converse with the called station. A separate key or switch shall be used for calling each of the other stations individually. (A conference key may be provided at one station to talk to a group or all of the other stations). Only one conversation at one time is required normally.

F. Intercommunication, selective ringing, selective talking system: In each office where shown on plans there shall be a sound intercommunicator of the selective type arranged so that any station may call and converse with any other station in the system. A "press-to-talk" switch shall connect the speaker-microphone so that the calling station may converse with the called station. A separate key or switch shall be used for calling each of the other stations individually. (A conference key may be provided at one station to talk to a group of all of the other stations.) As many conversations as there are pairs of stations are required normally.

Equipment

Aa. Install in each classroom a semi-flush permanent magnet dynamic type loudspeaker with 8 inch cone and baffle in walnut case. In laboratories, gymnasium and science rooms install a 10 inch loudspeaker in same type of case. In auditorium install two high

fidelity dynamic loudspeakers with directional horns equipped with 12 inch fidelity cone. Provide a volume control unit in auditorium and gymnasium for the loudspeakers.

Ab. Install on stage in auditorium a three-way polarized microphone receptacle with single gang metal plate, and a velocity microphone with switch mounted on an adjustable floor stand with 30 feet of cord and a plug. Install a microphone in the principal's office to be of the desk type complete with 10 feet cord, plug and receptacle.

Ac. Install in room where shown a free-standing cabinet containing the necessary voltage amplifier, power amplifier, radio receiver, phonograph reproducing unit, distribution switch panel, monitor loudspeaker and all controls for regulating volume and tone. The radio receiver shall be superheterodyne having high sensitivity over the entire broadcast, short-wave and frequency modulation bands. The phonograph reproducing unit shall be of the automatic record ejector type, suitable for playing a multiple of records at either 78, 45 or 33⅓ rpm. The monitor loudspeaker shall be of the 8 inch permanent magnet dynamic type and be provided with "talk-listen" switch for two-way conversation. Provide dynamic microphone with switch complete with desk stand, cable and plug.

Ba. (Same as paragraph Aa.)

Bb. (Same as paragraph Ab.)

Bc. (Similar to paragraph Ac. except with facilities for desired number of channels)

Ca. Install where shown a desk model amplified sound intercommunicator consisting of wood (or plastic) case and having mounted therein a speaker-microphone and amplifier. The surface of the case shall have a "press-to-talk" switch, a calling key or switch, a volume control switch and watchcase receiver and hook. Provide 6 feet of cable and plug.

Da. Install in manager's office a desk model amplified intercommunicator consisting of wood (or plastic) case and having mounted therein a speaker-microphone, amplifier and terminals. The surface of the case shall have a "press-to-talk" switch,—calling keys or switches, (name, number) a volume control switch and watchcase receiver and hook. Provide 6 feet of cable and plug.

Db. Install in all other offices where shown a desk model amplified intercommunicator outlying station consisting of wood (or plastic) case and having mounted therein a speaker-microphone, amplifier and terminals. The surface of the case shall have a "press-to-talk" switch, a calling key or switch, a volume control switch and watchcase receiver and hook. Provide 6 foot cable and plug for power, and flexible cable and terminal block for circuit wiring.

Ea. Install in all offices where shown a desk model amplified intercommunicator for selective ringing and common talking consisting of wood (or plastic) case and having mounted therein a speaker-microphone and amplifier. The surface of the case shall have a "press-to-talk" switch,—calling keys or switches, (name number) a volume control switch and watchcase receiver and hook. Provide 6 feet of cable and plug for power, and flexible cable and terminal block for circuit wiring.

Fa. Install in all offices where shown a desk model amplified intercommunicator for selective ringing and selective talking consisting of wood (or plastic) case and having mounted therein a speaker-microphone and amplifier. The surface of the case shall have a "press-to-talk" switch,—calling keys or switches, (name number) a volume control switch and watchcase receiver and hook. Provide 6 feet of cable and plug for power, and flexible cable and terminal block for circuit wiring.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus ten percent spares. Terminal strips must be mounted on a sheet of insulating material.

Operating Current

The system shall operate on 115 volts 60 cycle a-c (A,B). A separate circuit shall be run from the nearest lighting panel, (C,D,E,F). The intercommunicators shall be plugged into the nearest convenience receptacle by means of the flexible cord and plug provided with the units.

Wiring

All wiring shall be in approved conduit in the same manner as for the lighting system. The wires from the source of current shall be rubber covered. (A,B) 2 No. 14 B & S gauge, (C,D,E,F) 2 No. 18 B & S gauge in flexible cord with plug. (A,B) Wiring from the main terminal cabinet adjacent to the control cabinet shall be in flexible cable supplied by the manufacturer of the system. Wiring from the main terminal cabinet to individual room loudspeakers shall be 2 No. 18 B & S gauge rubber covered and cotton braid with steel shield. Wiring to auditorium speakers shall be 2 No. 14 B & S gauge and 2 No. 18 B & S gauge. Wiring to auditorium volume control 5 No. 16 B & S gauge. Wiring to auditorium microphone receptacle 1 lead sheathed covered twisted pair No. 19 B & S gauge in separate conduct. Ground wire No. 12 B & S gauge from control cabinet to street side of water meter, 2 No. 14 B & S gauge from nearest lighting panel to control cabinet. Antenna lead-in wires to be carried from control cabinet to roof of building. (C) no extra wiring necessary. (D) Wiring between the master station and the outlying stations 3 common and 1 section to each outlying station No. 22 B & S gauge. (E) Wiring between all stations 3 common and 1 section to all No. 22 twisted. (F) Wiring between all stations 3 common and 1 pair section to all No. 22 twisted.

Finish

All cabinets shall be walnut (or some other standard finish) or as selected by the Architect.

7.15 PAGING SYSTEMS

A. Lamp annunciator, three and six call.
B. Central code transmitter.
C. Voice, multiple circuit.

General

Furnish and install a (trade name and/or number) paging system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications, and left in first class operating condition.

Operation

A. Lamp annunciator: In corridors at intersections and nurses' stations, doctors' lounge, library, auditorium, nurses' dining room and at other locations shown on plans there shall be a paging lamp annunciator. There shall also be enclosed therein a buzzer (or chime may be mounted adjacent to annunciator) with externally controlled cut-off switch. Adjacent to telephone switchboard operator there shall be a portable keyboard with three vertical rows of keys for paging three persons, (six rows of keys for paging six persons) and provided with flexible cable to a flush terminal cabinet mounted in wall. Operation of the buttons in the same vertical row will

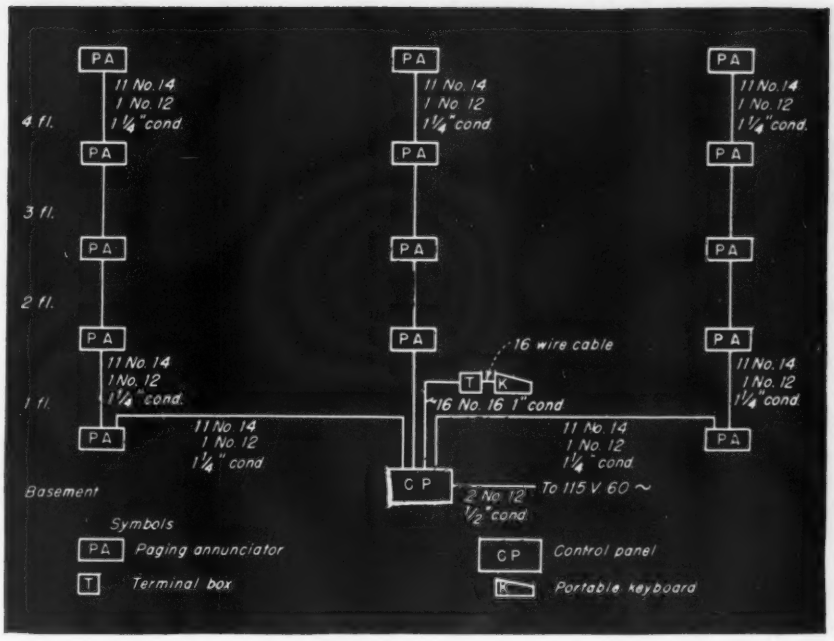
light and flash correspondingly numbered simultaneously in all lamp annunciators and pilot lights on the keyboard. When more than one person is to be paged additional vertical rows of buttons are operated and coded lamp signals appear in sequence and flash. System shall have a capacity of 120 calls using three digit code numbers. Additional buttons shall be included to connect or disconnect the system and to operate the audible signals to obtain special attention. A control cabinet shall be installed in the machine room located in the basement for controlling the load and the sequence of calls and the flashing of the lamps. To extinguish the lamp signals the reset button on the respective vertical row is operated.

B. Central code transmitter, single call system: In corridors, stockrooms, shops and other locations shown on the plans there shall be a heavy duty bar chime (single stroke bell, buzzer, single or double projector vibrating horn). Adjacent to telephone switchboard operator there shall be an automatic motor-driven code transmitter with "on and off" switch and facilities for setting up a pre-determined series of codes or impulses. Only one signal may be transmitted at one time but may be repeated as long as desired. (Capacity of transmitter determined by the number of persons to be paged)

C. Voice, multiple circuit system: In corridors, stockrooms, shipping room, shops and other locations shown on the plans there shall be a loudspeaker. Adjacent to the telephone switchboard operator there shall be a desk type microphone with "press-to-talk" switch complete with flexible cable, plug and receptacle. In addition there shall be a paging selector keyboard which shall enable the operator to connect each individual, group or riser of loudspeakers. A master switch shall be included to connect all loudspeakers simultaneously regardless of the position of the other switches.

Equipment

Aa. Install at each location where shown a lamp annunciator with suitable mounting for the locality. Case shall be of heavy steel construction with hinged doors. Single face flush, double and triple face vertical wall bracket mounted annunciators shall have ten lamps each. Double face ceiling or suspended horizontal mounting and double face partition mounted annunciators shall have two sets of ten lamps each. Size of indicators shall not be less than two inches high and shall have markings applied photographically or engraved on plastic sheet. Markings shall be 1 to 9 and 0. Buzzer shall be mounted in lower part of case and cut-off switch handle shall extend through bottom of case. (Where chime is mounted adjacent to annunciator buzzer is omitted and two terminals are provided for extension) Backbox to be provided by the manufacturer.



Riser layout silent paging system with buzzer.

Ab. Install where shown a portable selector keyboard consisting of three (or six) rows of metal locking buttons or switches, each button in a row representing a single digit indication on the annunciators, and arranged in a vertical position parallel to each other. In addition there shall be a "start and a stop" button, and an audible signal switch at the bottom of each vertical row. This unit shall be mounted on a 30 inch cast iron floor pedestal. A flexible cable 10 feet long shall be connected and brought out to a flush terminal cabinet for connection to the permanent wiring.

Ac. Install where shown a control panel enclosed in a surface steel cabinet with hinged door and lock with keys. This panel shall contain the necessary silent mercury contact relays, transformer for keyboard control, fuses, master switch and terminals.

Ba. Install where shown a heavy duty single stroke bar chime, single stroke bell (with 4, 6 or 10 inch gong) non-contact buzzer, single or double projector vibrating horns as indicated by symbol. These units shall be wound to operate in multiple on the maximum voltage of the system. These shall be designed to mount on standard outlet boxes.

Bc. Install where shown a silent mercury contact relay or relays enclosed in surface steel cabinet with hinged door and equipped with lock and keys, and connect with operating pushbutton. Relays shall be of sufficient size to carry the load of the entire signal devices.

Bb. Install where shown a synchronous motor-driven automatic code transmitter having an "on and off" switch, and a selector keyboard or dial for setting the transmitter to call desired person. Index card or sheet shall be provided thereon for inserting the names of the individuals. A flexible cord and plug shall be provided for connection to a 115 volt 60 cycle convenience receptacle, and another cord shall be provided to connect to the signal circuit.

Ca. Install where shown a permanent magnet, dynamic type loudspeaker single face flush, surface wall, double face wall bracket mounting or portable desk mounting as indicated by symbol. These speakers shall be equipped with volume control device and shall be of sufficient volume and size to be distinctly heard over the area in which they are installed.

Cb. Install where shown a portable type adjustable desk stand crystal microphone complete with flexible cable, plug and receptacle. A "press-to-talk" switch shall be provided on the microphone. (A floor type switch may be supplied with connecting cord to free operators hands).

Cd. A selector keyboard shall be provided with the microphone consisting of a portable cabinet containing a heavy duty switch for each individual, group or riser of loudspeakers and

equipped with a flexible cable and terminal block in surface housing. A master switch shall also be provided below circuit switches.

Cc. Install where shown a voice paging amplifier equipped with volume control, tone control, power switch, protecting fuses, multi-tap output transformer, and receptacle for microphone, enclosed in ventilated steel cabinet. This unit shall be of ample capacity to operate the entire system.

Terminal Strip Cabinets

Install where shown on plans flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus ten percent spares. Terminal strips shall be mounted on a sheet of insulating material.

Operating Current

The system shall operate from (A) a transformer having a capacity of— watts, primary 115 volts 60 cycle a-c secondary 24 volts (based on 15 va for each sounding device), (A, B, C,) 115 volts 60 cycle a-c. The source of power shall be derived from a separate circuit in the nearest lighting panel.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wires shall be color-coded and rubber covered. Feeder wires to control cabinets and relay cabinets shall be No. 10 B & S gauge. (A) Number of wires between the control cabinet or relay cabinet to annunciators 11 without audible signals, and 12 with audible signals, with common feeder wire No. 12 B & S gauge and lamp and audible signal section wires No. 14 B & S gauge. (A) Number of wires between the keyboard and relay cabinet 11 without audible signals, and 12 with audible signals, with common feeder wire No. 12 B & S gauge and lamp and audible signal section wires No. 14 B & S gauge for single call. Keyboard to control panel 15 wires without audible signals, and 16 with audible signals No. 16 B & S gauge for 3 to 6 call. (B) Number of wires between the relay cabinet and sounding devices 2 not smaller than No. 14 B & S gauge. (C) Number of wires from amplifier to loudspeakers 1 No. 18 B & S gauge rubber covered twisted pair (based on small installation in separate conduit: shielded wire if run in conduit with other systems). Number of wires from amplifier to loudspeakers 1 No. 18 B & S gauge rubber covered twisted pair for each separate section of loudspeakers. The amplifier requires 1 pair of No. 14 B & S gauge wires from the source of supply at nearest lighting cabinet.

Finish

The finish of all paging annunciators shall be (light ivory). Plates on control keyboards shall be (satin brass) or (satin nickel) as approved. Finish of control or relay cabinets shall be (dull black). Finish of other components shall be submitted to the Architect for approval.

7.16 FIRE ALARM SYSTEMS

A. Non-code, open-circuit, non-supervised.
B. Non-code, closed-circuit, supervised.
C. Master-code, closed-circuit, supervised.
D. Plain-code, closed-circuit, supervised.
E. Double-code, group, closed-circuit, supervised.
F. Coded pre-signal, closed circuit, supervised.
G. Coded shunt non-interfering, closed-circuit, supervised.
H. Coded positive non-interfering, closed-circuit, supervised.
I. Coded auxiliarized, Municipal connection.
J. Non-code, automatic, closed-circuit, supervised, (1) Wired, (2) Tube.
K. Coded, automatic, closed circuit, supervised, (1) Wired, (2) Tube.

General

Furnish and install a (trade name and/or number) fire alarm system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications, and left in first class operating condition.

Operation

A. Non-code, open-circuit, non-supervised system: At each stairway, exit and other locations shown on plans there shall be a non-code break-glass fire alarm station. At each location where shown there shall be a bell (or horn). Breaking the glass in any station shall cause all sounding devices to operate continuously until the glass has been replaced in the station which initiated the alarm. It shall also be possible to transmit a test signal from any station by opening the front cover by means of a key.

B. Non-code, closed-circuit, supervised system: At each stairway, exit, and other locations shown on plans there shall be a non-code break-glass fire alarm station. At each location where shown there shall be a bell (or horn or siren). Breaking the glass in any station shall cause all sounding devices to operate continuously until the glass has been replaced in the station which initiated the alarm. It shall also be possible to transmit a test signal from any station by opening the front cover by means of a key. The stations and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. A trouble bell shall also be provided and shall sound continuosuly in the event of interruption of the operating current, or a break in the system wiring or connections.

C. Master-code, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans, there shall be a non-code break-glass fire alarm station. At each location shown there shall be a bell (or horn). Breaking the glass in any station shall cause the master-code mechanism on the control panel to trip and transmit a common code on all sounding devices in the system. It shall also be possible to transmit a test signal from any station by opening the front cover by means of a key. The stations and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. The trouble bell shall sound continuously until the glass is replaced in the station which initiated the alarm, and the master code mechanism has been rewound. The trouble bell shall also operate continuously in the event of interruption of the operating current, or a break in the system wiring or connections.

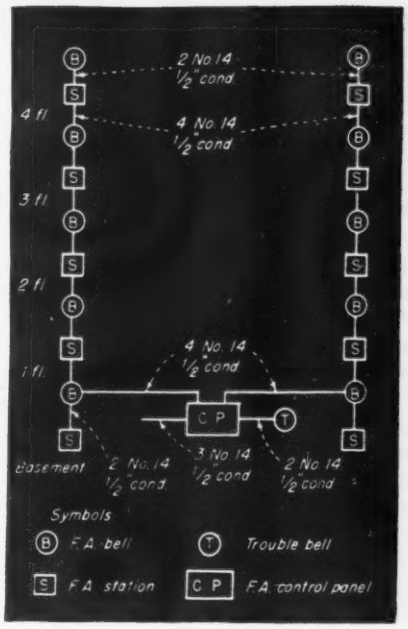
D. Plain-code, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans there shall be a plain-code, closed-circuit, general alarm type fire alarm station. At each location shown there shall be a bell (or horn). Pulling and releasing the lever of any station shall cause the code number of that station to be sounded on all signal devices in the system. The stations and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. It shall be possible to make a single tap test, and a silent running test on any station by inserting a key into an opening provided therefore, and turning it in either of two directions. The bell shall sound in the event of interruption of current or a break in the system wiring or connections.

E. Double-code, group, closed-circuit; supervised system: At each stairway, exit and other locations shown on plans of the main building there shall be a double-code, closed-circuit fire alarm station. At each location shown there shall be a local or general alarm bell (or horn). In the service and employees buildings there shall be the same type of stations and sounding devices. Pulling and releasing the lever of a station in the main building shall cause the simultaneous transmission of two separate and distinct codes. One set of codes shall be used to operate the local alarm sounding devices in the main building, while the other set of codes shall be used to operate the general alarm sounding devices in the service and employees buildings. Stations located in the service and employees buildings shall operate all local alarm sounding devices in the building where the alarm originates, and in addition operate all general alarm sounding devices in the other service and employees buildings and also in the main building. The stations and sounding devices in each building shall be connected to a separate group type control panel located in its respective building which shall permit a small supervisory current to pass through the entire system. It shall be possible to make a single tap test, and a silent running test on any station by inserting a key into an opening provided therefor, and turning it in either of two directions. The trouble bell shall sound at each control panel affected and operate continuously in the event of interruption of the operating current or a break in the system wiring or connections. A permanent record of each alarm shall be made on a punch register located near the control panel in the main building, together with the time of the day transmitted. This shall be accomplished by an automatic time stamp interconnected with the punch register.

F. Coded pre-signal, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans there shall be a coded pre-signal, closed-circuit fire alarm station. At each location shown there shall be a general alarm bell or a pre-signal bell or chime as indicated. Pulling and releasing the lever of the station shall cause the code number of that station to be sounded on all pre-signal sounding devices only. Inserting a special general alarm plug in an opening provided therefor on the face plate containing the pull lever, and then pulling and releasing the lever, shall cause the code number of that station to sound on all signal devices, both pre-signal and general alarm throughout the system. The stations and sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire system. It shall be possible to make a single tap test, and a silent running test on any station by inserting a key into an opening provided therefor, and turning it in either of two directions. The trouble bell shall sound continuously in the event of interruption of the operating current, or a break in the system wiring or connections.

G. Coded shunt non-interfering, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans there shall be a coded shunt non-interfering fire alarm station. At each location shown there shall be a bell (or horn). Pulling and releasing the lever of the station shall cause the code number of that station to be sounded on all signal devices in the system. The shunt non-interference feature shall function to insure that when a station is operating, no other station, electrically farther away from the control panel, shall interfere with its operation. The stations and sounding devices shall be connected to a control panel, which shall permit a small supervisory current to pass through the entire system. It shall be possible to make a single tap test, and a silent running test on any station by inserting a key into an opening provided therefor, and turning it in either of two directions. The trouble bell shall sound continuously in the event of interruption of the operating current or a break in the system wiring or connections.

H. Coded positive non-interfering, closed-circuit, supervised system: At each stairway, exit and other locations shown on plans there shall be a coded, positive non-interfering fire alarm station. At each location shown there shall be a bell (or horn). Pulling and releasing the lever of the station shall cause the code number of that station to be sounded on all sounding devices in the system. The positive non-interfering feature shall function to insure that when a station is operating, no other station shall interfere with its proper transmission of impulses. Should two or more stations be pulled at or about the same time, the station first securing the line will complete its code signal without interference from subsequently operated stations. The stations and sounding devices shall be connected to a control panel, which shall permit a small supervisory current to pass through the entire system. The trouble bell



Riser layout plain code fire alarm system.

shall sound continuously in the event of interruption of the operating current or a break in the system wiring or connections until the defect is remedied. It shall not be possible to silence the trouble bell except by a throw-over switch on the control panel which automatically transfers the trouble signal to a red lamp also located on the panel. Lamp is to remain lighted until the trouble is remedied, then switch is to be returned to its normal position. A record of all alarms shall be made on a punch register and the time of such alarm shall be imprinted on the register tape by means of an automatic time stamp.

I. Coded auxiliarized, Municipal connected system: At each stairway, exit and other locations shown on plans there shall be a coded, auxiliarized fire alarm station. At each location there shall be a bell (or horn). Breaking the glass in the door and pulling and releasing the lever of the station shall cause the code number of that station to be sounded on all signal devices in the system, and transmit the alarm simultaneously to the City Fire Department by tripping a City Master Fire Alarm Station located in the switchboard operator's office (or located on a pedestal on the street in front of the building). Interlocking contacts shall be provided on the station to prevent false alarms from being transmitted to the municipal system. For fire drills it shall be necessary to first open the station door by means of a key. The pulling of the lever under this condition shall only cause the signal devices to operate within the confines of the building. A warning signal shall be given on

the control panel, immediately, when the glass is broken or when the door springs open on a station. The trouble signal continues to operate as long as a station door remains open after transmitting an alarm or a drill signal. The stations and the sounding devices shall be connected to a control panel, which shall permit a small supervisory current to pass through the entire system. The system shall be double supervised using distinctively toned trouble bells, two in number, each with pilot lamps and silencing switches.

J. Non-code, automatic, closed-circuit, supervised system: In all rooms, corridors, closets, shops, storerooms, attic and other locations shown on plans there shall be mounted on the ceilings (1) thermostatic detectors of the rate-of-rise and fixed temperature type, (2) thermostatic detector tubing, (1, 2) properly spaced and installed to result in maximum protection. in accordance with the Underwriters' requirements. At each location shown there shall be a bell (or horn). In the event of a fire the rapid rise in temperature shall be automatically detected by the thermostatic elements, which in turn shall cause all sounding devices to operate continuously throughout the system. The thermostatic elements and the sounding devices shall be connected to a control panel which shall permit a small supervisory current to pass through the entire wiring of the system. The trouble bell shall sound continuously in the event of interruption of the operating current or a break in the system wiring or connections until the defect is remedied. The trouble signal shall include a transfer switch and a pilot light. It shall be possible to make periodic tests on the thermostatic elements whenever desired.

K. Coded, automatic, closed-circuit, supervised system: In all rooms, corridors, closets, shops, storerooms, attic and other locations shown on plans there shall be mounted on the ceilings (1) thermostatic detectors of the rate-of-rise and fixed temperature type, (2) thermostatic detector tubing, (1, 2) properly spaced and installed to result in maximum protection in accordance with the Underwriters' requirements. At each location shown there shall be a bell (or horn), and an electrically tripped transmitter. In the event of a fire, the rapid rise in temperature shall be automatically detected by the thermostatic elements, which in turn shall cause a code signal to be sounded on all sounding devices, indicating the zone or section of the system in which the alarm originated. The thermostatic elements and the sounding devices shall be connected to a control panel (which may also contain the transmitters on smaller systems). A small supervisory current shall pass through the entire wiring system. The trouble bell shall sound continuously in the event of interruption of the operating current or a break in the system wiring or connections, and when the transmitters require winding and until the trouble is remedied. The trouble signal shall include a transfer switch and a pilot light. It shall be possible to make periodic tests on the thermostatic elements whenever desired.

Equipment

Aa. Install where shown a flush (or surface) non-code break-glass hammerless fire alarm station, with hinged front door and lock with key arranged for making tests without breaking glass, and for easy replacement of the glass when broken. Flush station shall mount on standard outlet box with single gang cover. (surface station is provided with back-casting by manufacturer)

Ab. Install where shown on plans an underdome vibrating plunger type bell (4, 6 or 10 inch size), or heavy duty type vibrating horn of the single or double projector type as indicated by symbol. These signal devices shall all be wound for multiple operation.

Ba. (Same as paragraph Aa.)

Bb. Install where shown an underdome vibrating plunger type bell (4, 6 or 10 inch size), or heavy duty type vibrating horn of the single or double projector type as indicated by symbol. These signal devices shall all be wound for series operation.

Bc. Install where shown a closed-circuit fire alarm control panel in surface (or flush) wall type steel cabinet equipped with hinged door with lock and keys. Panel shall contain all necessary relays, meter, resistances, thermal cut-out, terminals and fuses for the control and supervision of the system. Panel shall be single supervised (unless double supervised is specified) and shall operate on 115/230 volts, 3 wire supply current. Panel shall contain number of bell and station circuits required. A trouble bell shall be provided for external connection.

Ca. (Same as paragraph Aa.)

Cb. Install where shown an underdome single stroke plunger type bell (4, 6 or 10 inch size) or heavy duty vibrating horns of the single or double projector type as indicated by symbol. These signal devices shall all be wound for series operation.

Cc. Install where shown a closed-circuit fire alarm control panel of the master type in surface (or flush) wall type steel cabinet equipped with hinged door with lock and keys. Panel shall contain all necessary relays, meter, resistances, thermal cut-out, 4 round master code mechanism, terminals and fuses for the control and supervision of the system. Panel shall be single supervised (unless double supervised is specified) and shall operate on 115/230 volts, 3 wire supply current. Panel shall contain number of bell and station circuits required. A trouble bell shall be provided for external connection.

Da. Install where shown a semi-flush (or surface or weatherproof) plain code, closed-circuit, pull lever, four round code type fire alarm station with break-glass (or open) door. Stations shall be provided with a code wheel, coded as required. Facilities shall be included for making a single tap test and silent running test with key. Backbox to be provided by the manufacturer.

Db. (Same as paragraph Cb.)

Dc. (Same as paragraph Bc.)

Ea. Install where shown a semi-flush (or surface or weatherproof) double code, closed-circuit, pull lever, four round code fire alarm station with break-glass (or open) door. Stations shall be provided with two code wheels, coded as required, two sets of contacts, and two sets of terminals. Facilities shall be included for making a single tap test and silent running test with key. Backbox to be provided by the manufacturer.

Eb. (Same as paragraph Cb.)

Ec. Install where shown in main building a closed-circuit master fire alarm control panel. In other buildings install a closed-circuit local fire alarm control panel. Panels shall be mounted in surface (or flush) wall type steel cabinets equipped with hinged doors with lock and keys. Panels shall contain all necessary relays, meters, resistances, thermal cut-outs, terminals and fuses for the control and supervision of the system in their respective areas. The system shall be single supervised (unless double supervised is specified) and shall operate on 115-230 volts, 3 wire supply current. Panels shall contain number of bell and station circuits required. Trouble bells shall be provided for external connections.

Fa. Install where shown a semi-flush (or surface) pre-signal, pull lever, four round type fire alarm station with break-glass (or open) door. Stations shall be provided with one code wheel, coded as required. A jack shall be provided on the pull lever plate for insertion of plug or key. Facilities shall be included for making a single tap test and silent running test with key. Back-

box for the installation to be provided by manufacturer.

Fb. (Same as paragraph Cb.)

Fc. (Same as paragraph Bc.)

Ga. Install where shown a semi-flush (or surface or weatherproof) plain code, shunt non-interfering, closed-circuit, pull lever, four round codetype fire alarm station with break-glass (or open) door. Station shall be provided with a code wheel, coded as required, and with shunt circuit contact springs. Facilities shall be included for making a single tap test and silent running test with key. Backbox to be provided by the manufacturer.

Gb. (Same as paragraph Cb.)

Gc. (Same as paragraph Bc.)

Ha. Install where shown a semi-flush (or surface or weatherproof) positive non-interfering, closed circuit, pull lever, four round code type fire alarm station with break-glass (or open) door. Stations shall be provided with a code wheel, coded as required and non-interference coil and contact springs. Backbox to be provided by the manufacturer.

Hb. Install where shown an underdome, single stroke, electro-mechanical bell with 10 inch gong suitable for operation on a normally closed-circuit of 100 to 110 milliamperes direct current. Bells to have prewound mechanism capable of striking not less than 500 blows on one winding. At the location of the punch register install a 6 inch back-stroke tapper bell, wall mounting type to operate on same current requirements.

Hc. Install where shown a closed-circuit fire alarm panel in surface (flush or free-standing) steel cabinet, having hinged doors with lock and keys. Panel shall contain all necessary apparatus for the operation and supervision of the complete system, comprising the proper number of loops for the stations and bells. Each loop shall have its own set of instruments and arranged to entirely remove a loop from the circuit without affecting the remainder of the system. Provide double supervision for the circuits complete with trouble bells with pilot lights and silencing switches.

Ia. Install where shown a semi-flush (or surface or weatherproof) auxiliary, closed-circuit, pull lever, four round code type fire alarm stations with break-glass door. Stations shall be provided with a code wheel, coded as required and with municipal alarm interlocking contacts for sending an alarm. A cylinder lock shall be provided on the door to permit fire drills without sending alarms to the municipal system. Backbox to be provided by the manufacturer.

Ib. (Same as paragraphs Cb. or Hb.)

Ic. Install where shown a closed-circuit double supervised fire alarm control panel in surface (or flush) wall type steel cabinet equipped with hinged door with lock and keys. Panel shall contain all necessary relays, meters, resistances, thermal cut-out, terminals and fuses for the control and supervision of the interior system, and a special switch and separate terminals for connection to the municipal system. Panel shall operate on 115-230 volts 60 cycle a-c, 3 wire supply current. Panel shall contain number of bell and station circuits required. Two trouble bells shall be provided for external connections together with trouble pilot lights and silencing switches.

Ja. Install where shown thermostatic detectors of the rate-of-rise and fixed temperature type with open-circuit contacts and mounted on round outlet boxes and covers, for operation on 165 degrees Fahrenheit. (2) thermostatic detector non-corrosive metal tubing with fitting and fastening facilities.

Jb. (Same as paragraph Bb.)

Jc. (Same as paragraph Bc.)

Ka. (Same as paragraph Ja.)

Kb. (Same as paragraph Bb.)

Kc. Install where shown a semi-flush (or surface) closed-circuit, combination pull lever and electrically tripped transmitter with break-glass door with four round code movement. Stations shall be provided with a code wheel, coded as required, and a trip coil. Backbox to be provided by the manufacturer.

Kd. (Same as paragraph Bc. when electrically tripped stations are used. Same as paragraph Cc. if electrically tripped movement is on control panel)

Special Features

(D, E, F, G, H, I, K) Install where shown on plans a punch register, take-up reel and automatic time stamp mounted on shelf with overall enclosing glass cover and supported on metal brackets. Stamping coil of time stamp to operate on 115 volts 60 cycle a-c. Clock to operate from an a-c synchronous motor on same voltage. (Time stamp may also operate from a master clock system as described in 7.20, Electric Clock Systems).

Terminal Strip Cabinets

Install where shown a flush steel cabinet with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus ten percent spares. Terminal strips shall be mounted on a sheet of insulating material.

Lightning Protection

Install in each building where overhead lines enter, lightning protectors on each line, and enclose same in surface steel cabinet.

Operating Current

The system shall operate from (A) a transformer having a capacity of—— watts (based on 15 va. for each sounding device), (A,B,C,D,E,F,G,I,J,K) 115 volts 60 cycle a-c, (H) a dry plate rectifier power supply with stand-by storage battery of proper voltage and current output mounted on battery rack, (A,B,C,D,E,F,G,H,I,J,K) connected directly to a separate circuit from the nearest lighting panel.

Install where shown a cut-out box, surface type of steel construction with hinged door with lock and keys. This cabinet shall contain the proper size fuse for each "hot wire" and provided with a solid neutral. Door shall be finished in red and stenciled with the wording "Fire Alarm".

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wires shall be color-coded and rubber covered. Feeder wires to control panels shall be No. 10 B & S gauge. All wires to fire alarm stations shall not be smaller than No. 14 B & S gauge. All wires to fire alarm sounding devices shall not be smaller than No. 14 B & S gauge (on large projects No. 12 B & S gauge). (A) Number of wires on 24 volt system between relay and sounding devices and stations 3. On transformer or 115 volts 2 wires to first sounding device and station, 3 thereafter. (B,C,D) Number of wires from control panel to combination of sounding devices and stations 4. (E,F,G,I) Number of wires between control panel and combination of sounding devices and stations 6. (H) Number of wires between control panel and series of sounding devices and stations 2. (J,K) Number of wires between control panel and thermostatic detectors 2.

Finish

The finish of all fire alarm stations, bases of sounding devices and cabinets with control panels, terminal strips, fuses and lighting protectors shall be "fire alarm red" unless otherwise noted. Gongs of bells to be dull black unless other wise noted. Stations in main lobbies shall be of cast bronze. Bells in main lobby shall be installed behind flush bronze grille, design to be selected by the Architect.

7.17 PUBLIC TELEPHONE SYSTEM

A. Single station.

B. Main station, one or two extensions.

C. Private branch exchange.

D. Automatic private branch exchange.

E. Distribution system, multiple occupancy building.

General

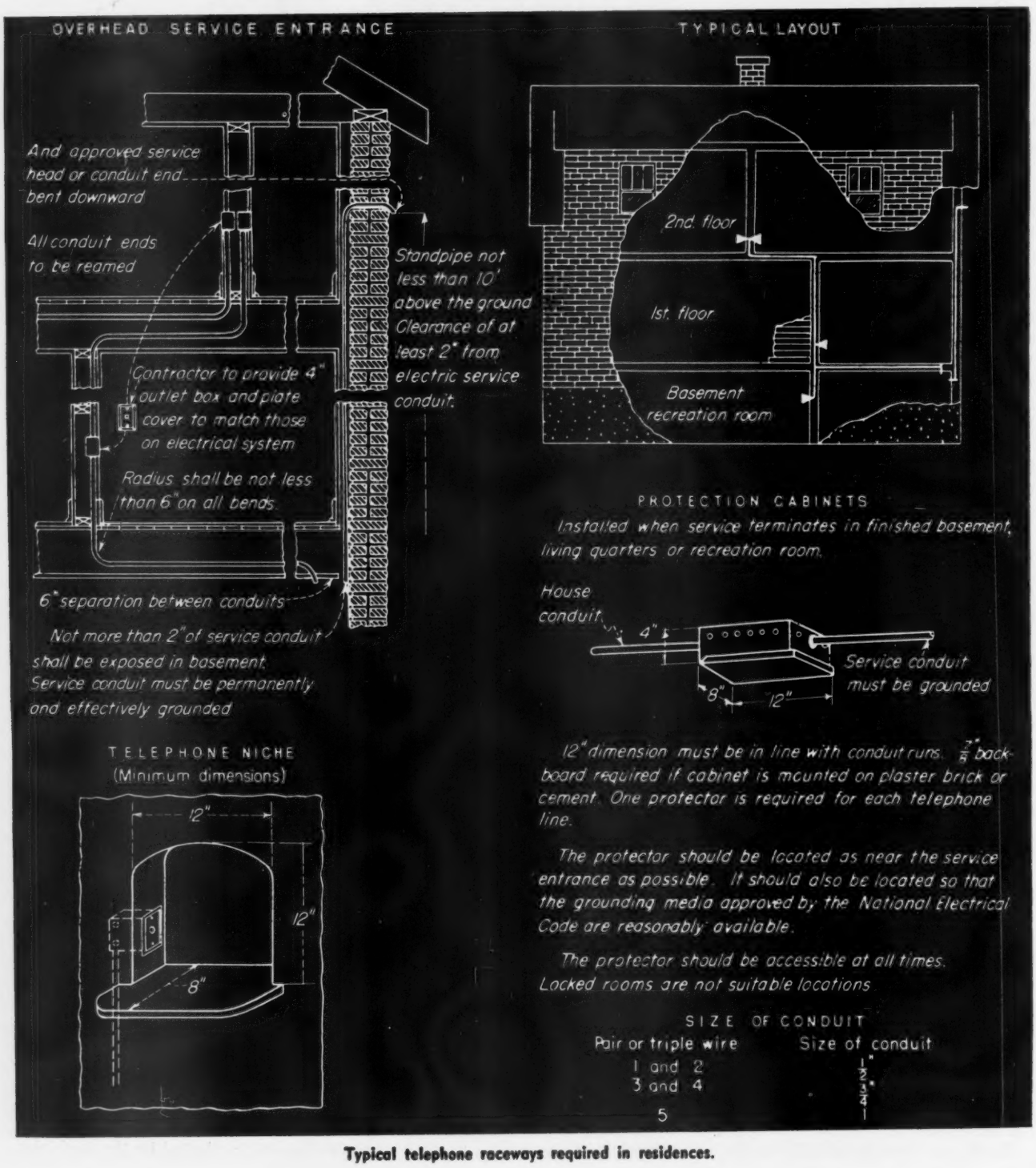
Furnish and install a conduit system for the public telephones as recommended and specified by the (name of local public telephone company) and described in these specifications and indicated on wiring plans.

Description

A. Single station: Install complete conduit and wiring system for one desk type telephone.

B. Main station, one or two extensions: Install complete conduit and wiring system for three desk type telephones, with trunk and switching keys mounted in base. Any telephone to be capable of answering incoming calls and transferring them to any other in the system.

C. Private branch exchange: Install complete conduit and wiring system for a manual type telephone switchboard in receptionist room and extensions therefrom to all desk type and wall type telephones. This shall include necessary terminal strip cabinets,



Typical telephone raceways required in residences.

ground wire connections and protectors.

D. Automatic private branch exchange: Install complete conduit and wiring system for an automatic exchange system. All wires shall terminate in the machine room and extend to the telephone wire racks adjacent to the machine switching apparatus. Conduit and wires shall also be provided for rectifiers, batteries, chargers, etc. and extended to terminal strip cabinets and telephone outlets, ground wire connections and protectors.

E. Distribution system, multiple occupancy building: Install complete conduit and wiring system for the trunk lines from the service entrance to the terminal cabinets on designated floors, and extend from these points to the tenants premises. Provide underground conduit from the building to a point in the street designated by the telephone company.

Terminal Strip Cabinets

These cabinets shall be supplied and installed as required by the telephone company less terminal strips, however, they must be of proper size and have the proper gutter requirements.

7.18 WATCHMAN'S TOUR SYSTEMS

A. Compulsory recorded tour.

B. Supervisory proprietory tour.

C. Central station.

General

Furnish and install a (trade name and/or number) watchman's tour system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

Operation

A. Compulsory recorded tour system: At each location shown on plans there shall be a watchman's tour station. The first and last stations of each tour shall be electrical transmitters, all others between these two points are to be of the mechanical type. In superintendent's office install a paper tape printing recorder. Operation of the first electrical transmitter by inserting a special key shall cause to be printed in the recorder a designation for the "Start" of the tour. The key shall be so arranged that it will only operate in sequence from one station to the other, and shall be "set up" when inserted in one station to fit into the following station. The key when inserted in the last electrical transmitter shall record the "Finish" of the tour.

B. Supervisory proprietory tour system: At each location shown on plans there shall be a watchman's tour station. All stations are provided with a jack and pilot lamp. In guard's room install a supervisory desk with recording and communication facilities. A handphone with cord and heavy duty plug, dummy plug and leather carrying case shall be provided for each guard. The guard on each tour normally inserts the dummy plug in every station consecutively. This causes an indicating drop on an annunciator at the desk to come into view for each station, and also records the time of the visit on a chart. The guard may converse with the chief guard from every outlying station by connecting the handphone. The chief guard may call a guard on a tour by operating a tour control key at the desk which lights all pilot lamps on the stations for that tour. The guard answers the chief guard by connecting the handphone.

C. Central station system: (Similar to system A. except that the recording is transmitted to a central station operating company.)

Equipment

Aa. Install at the first and last stations in the tour an electrically operated transmitter consisting of clock mechanism and contact springs mounted behind faceplate having an opening for insertion of tour key. At all other locations install an intermediate mechanical station. Provide one tour key for each guard or tour.

Ab. Install in superintendent's office a metal case tour recorder with synchronous motor driven clock and magnetically operated printing mechanism complete with paper tape and rollers. Recording shall indicate "start" or "finish" of tour, and time of visit. Each tour shall have separate terminal connections.

Ba. At each location shown install a watchman's station consisting of a cast metal plate having mounted thereon a heavy duty jack and a bullseye with lamp and receptacle complete with backbox.

Bb. In guard room install a metal desk with turret having mounted thereon a central panel with an electrical reset annunciator equipped with ———drops (name number based on one drop for each station on a tour), route control keys and pilots, loudspeaker and handphone with cord and plug. The left hand panel shall contain the synchronous motor driven chart recorder. The right hand panel shall contain the charging meter and control equipment for the battery. The lower rear section shall contain all terminal strips for the circuit wiring.

Bc. In machine room in basement install a complete storage battery and rack with dry plate rectifier charger arranged for trickle and booster charging. The voltage and the size of the battery cells shall be as recommended by the manufacturer of the system for use in service.

Ca. (Same as paragraph Aa.)

Cb. Install in superintendent's office a metal cabinet with hinged door and equipped with lock and keys. This cabinet shall contain the central station transmitter complete with control and test equipment and terminal strips to extend wiring to exterior wiring. This cabinet shall be installed in accordance with the requirements of the central station operating company.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus ten percent spares. Terminal strips must be mounted on a sheet of insulating material.

Operating Current

The system shall operate from (A) 115 volts 60 cycle a-c, (B) storage battery with voltage and current output in accordance with the manufacturer's recommendation, (C) central station operating company's source of current, (A, B) derived from separate circuit from nearest lighting panel.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wires for the signal circuits shall be color-coded and rubber covered. (A) 2 No. 14 B & S gauge, (B) Section and common signal wires No. 16 B & S gauge with telephone wires twisted No. 19 or No. 22 B & S gauge, (C) wiring as recommended by the central station operating company.

7.19 IN AND OUT REGISTER SYSTEMS

A. Magnetic drop annunciator.
B. Lamp annunciators, entrance and office registers.
C. Lamp annunciators, with message feature.
D. Lamp annunciators, two entrances.

General

Furnish and install an (trade name and/or number) In and Out register system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications, and left in first class operating condition.

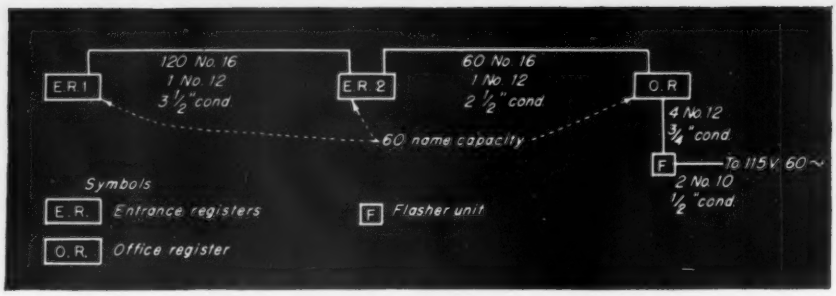
Operation

A. Magnetic drop annunciator system: In corridor near entrance where shown there shall be an entrance register pushbutton plate. Adjacent to the telephone switchboard operator there shall be an annunciator of the electric reset type. Upon entering the building, a member of the staff shall operate the "On" button at the entrance register which shall cause a corresponding electric reset drop in the annunciator to come into view. The drop remains in this position until the associated "Off" button is operated and results in resetting the drop.

B. Lamp annunciators, entrance and office register system: In corridor near main entrance as shown there shall be an entrance register of the lamp type with an illuminated name compartment and a control switch for each member of the staff. In the telephone switchboard room there shall be a similar unit, an office register, with an illuminated cardholder less control switch for each member of the staff. Operation of a switch on the entrance register shall illuminate the adjacent lamp compartment and will also illuminate the associated name compartment on the office register. Lamps at both points remain lighted until the control switch on the entrance register has been returned to its original position.

C. Lamp annunciators, with message feature system: In corridor near main entrance as shown there shall be an entrance register of the lamp type with an illuminated name compartment and a control switch for each member of the staff. In the telephone switchboard room there shall be an office register with an illuminated name compartment and a control switch for each member of the staff. In the machine room located in the basement there shall be a flasher control cabinet to operate with the system. Operation of a switch on the entrance register shall illuminate the adjacent lamp compartment and will also illuminate the associated name compartment on the office register. These lamps shall light steadily until the operator actuates the switch on the same circuit, when the lamps flash at regular intervals. Lamps at both points remain lighted until the control switch on the entrance register has been returned to its original position. The operator shall be able to operate a control switch and prepare the circuit prior to the switch being actuated in the entrance register, however, the lamps will not flash until the associated switch in the entrance register is placed in the "On" position.

D. Lamp annunciators, two entrance system: In corridor near main entrance, and in corridor near rear entrance as shown there shall be an entrance register of the lamp type with an illuminated name compartment and a control switch for each member of the staff. In the telephone switchboard room there shall be a similar unit, an office register with an illuminated name compartment less switch for each member of the staff. Operation of a switch at either entrance will illuminate the adjacent name compartment at each entrance and the associated name compartment in the office register. Lamps at all three points remain illuminated until either entrance register switch associated with these lamps have been operated.



Layout In and Out register system.

Equipment

Aa. Install near entrance where shown a flush (or surface) entrance register pushbutton plate consisting of two pushbuttons for each person, one with white center to indicate "In", one with black center to indicate "Out". The capacity shall be for .... (state number) persons. Each pair of pushbuttons shall have a cardholder for inserting an engraved plastic plate with person's name. Front plate shall be of heavy steel construction, hinged on a frame and equipped with lock and keys. Connections from pushbuttons shall be cabled to terminal strip which shall be fastened to rear of backbox.

Ab. Install in telephone switchboard room where shown a flush (or surface) electric reset annunciator with indicator and cardholder for each person. There shall be a total of—(state number) drops. Front plate shall be of heavy steel construction, hinged on frame and equipped with lock and keys. Connections from indicator drops shall be cabled to terminal strip which shall be fastened to rear of backbox.

Ba. Install near entrance where shown a flush (or surface) entrance register consisting of a separate name compartment with receptacle, lamp and transparent engraved plastic name strip for each member of the staff. Adjacent thereto shall be mounted a single pole tumbler control switch. The capacity shall be for—(name number) persons. Doors shall be fitted into bronze frame and each door shall be equipped with lock and keys. Name compartments and switches shall be mounted in bronze pierced doors. Backbox to be furnished by the manufacturer.

Bb. Install in telephone switchboard room where shown a flush (or surface) office register similar to the entrance register except that the control switches are to be omitted.

Ca. (Same as paragraph Ba.)

Cb. Install in telephone switchboard room where shown a flush (or surface) office register consisting of a separate name compartment with receptacle, lamp and transparent engraved plastic name strip for each member of the staff. Adjacent thereto shall be mounted a three-way tumbler control switch. The capacity shall be for .... persons. Doors shall be fitted into bronze frame and each door shall be equipped with lock and keys. Name compartments and switches shall be mounted in bronze pierced doors. Backbox to be furnished by the manufacturer.

Cc. Install in machine room a flashing control panel enclosed in surface steel cabinet with hinged door equipped with lock and keys. The panel shall contain a silent mercury contact relay, an a-c synchronous motor with flashing device, terminal strip and a transformer to operate the complete system.

Da. Install near main and rear entrances where shown a flush (or surface) entrance register consisting of a separate name compartment with receptacle, lamp and transparent engraved plastic name strip for each member of the staff. Adjacent thereto shall be mounted a three-way tumbler control switch. The capacity shall be for . . . . persons. Doors shall be fitted into bronze frame and each door shall be equipped with lock and keys. Name compartments and switches shall be mounted in bronze pierced doors Backbox to be furnished by the manufacturer.

Db. (Same as paragraph Bb.)

Operating Current

The system shall operate from a transformer having a capacity of— watts (based on 4 watts per lamp and three-quarter total load) primary 115 volts 60 cycle a-c. (A,B,C) secondary 24 volts, (D) secondary 36 volts; (A,B,C,D) connected on a separate circuit from nearest lighting panel.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wire shall be color-coded and rubber covered. Feeder wires (A) shall be No. 16 B & S gauge, (B,C,D) shall not be smaller than No. 14 B & S gauge. Section wires (A,B,C,D) shall be No. 16 B & S gauge. Number of wires between entrance register and office register (A) 2 for each drop plus 1 feeder wire, (B) 1 for each circuit plus 1 feeder wire from transformer to entrance register and 1 feeder wire from transformer to office register, (C) 1 for each circuit plus 1 feeder wire from transformer to entrance register and 2 feeders from transformer to office register plus 1 between flasher control cabinet and office register, (D) for each circuit plus 2 feeder wires from transformer to each entrance register.

Finish

The finish of (A) entrance register pushbutton plate and the office register annunciator shall be light ivory, (B,C,D) entrance and office registers shall be medium statuary bronze. (C) Finish of flasher control cabinet shall be dull black.

7.20 ELECTRIC CLOCK SYSTEMS

A. Synchronous, single motored clocks, no central control.
B. Synchronous, single motored clocks, central control.
C. Synchronous, dual motored clocks, central control (1) Manual (2) Automatic.
D. Synchronous, single motored clocks, central control, hourly correction.
E. Master and secondary clocks.
F. Electronic controlled clocks.

General

Furnish and install an (trade name and/or number) electric clock system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturers specifications and left in first class operating condition.

Operation

A. Synchronous single motored clocks, no central control system: At each location where shown there shall be a single synchronous motored clock, connected on a separate circuit (or plugged into hanger receptacle) with not more than 25 connected thereto. All clocks shall operate individually from the ligthing circuit. Clocks shall be provided with a manual reset device.

B. Synchronous single motored clocks, central control system: At each location where shown there shall be a single synchronous motored clock. In supervisor's office there shall be an automatic control panel which shall correct the time on all clocks in the event of an interruption of current. Normally the clock operates from the motor at the standard speed. When an interruption has occurred the control panel shall automatically connect the clock motors to a motor-generator set having an output of double the frequency and cause the clock motors to speed up upon the return of the current supply. When the correct time has been established the generator is automatically disconnected and the clock motors operate at their normal speed. All clocks in the system shall be connected in multiple and the wires shall terminate in the control panel.

C. Synchronous dual motored clocks, central control system: At each location where shown there shall be a synchronous motored clock with two motors. In supervisor's office there shall be (1) a manual control unit, (2) an automatic control unit, (1,2) which shall correct the time on all clocks simultaneously, in the event of an interruption of current. Normally the clock movements operate on the standard speed motor. When clocks are "slow" the high speed motor advances the clocks to the correct time. When the correct time has been established, the normal speed motors are returned to the circuit.

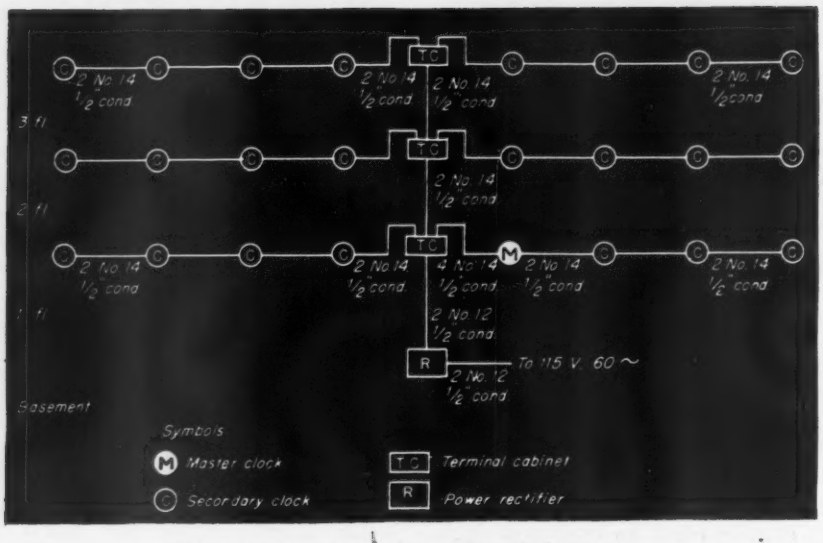
D. Synchronous single motored clocks, central control, hourly correction system: At each location where shown there shall be a single synchronous motored clock. In supervisor's office there shall be an automatic clock control panel, which shall correct the time hourly. Normally the clock movement operates from the motor at normal standard speed. When any clock is "fast" it is held at a designated point until all other clocks advance to the same time, then all clocks advance in unison. When any clock is "slow" it is speeded up until it reaches a designated point and then it advances with all other clocks which were held immobile.

E. Master and secondary clock systems: At each location where shown there shall be a secondary minute impulse clock. In supervisor's office there shall be a master clock which shall transmit electrical impulses once each minute to all secondary clocks, time stamps and card time recorders and advance them one minute at a time under normal conditions. The master clock shall correct the secondary clocks once each hour at some pre-determined point, whether "fast" or "slow".

E. Electronic controlled clock system: At each location where shown there shall be an electronic controlled secondary clock. In supervisor's office there shall be an electronic master clock which shall transmit radio impulses once each hour to all secondary clocks. Upon receipt of the hourly supervisory impulse, each secondary clock initiates its own self-corrective cycle, whether "fast" or "slow". The high frequency current shall be transmitted from the master clock to fixed frequency electronic receivers in the secondary clocks over direct wire connections fully metallic circuit. (The secondary clocks may also be connected at any outlet if desired.

Equipment

Aa. Install in each room a flush (or surface) synchronous motored a-c clock with single motor having a 12 inch (or 10 or 15 inch) dial in round spun metal case with convex cover glass, complete with outlet box (or



Riser layout master and secondary clock system.

hanger plate outlet with cord and plug). In corridors install a double face wall bracket mounting (or ceiling suspended) clock with 14 inch (or 18 inch) dials in round spun metal case having metal bracket wall supports (or chain supports) with convex cover glasses complete with backbox. Clocks shall be equipped with manual reset device.

Ba. (Similar to paragraph Aa. except that cords and plugs are omitted)

Bb. In supervisor's office install an automatic control panel complete with necessary relays, control and timing equipment for connecting and disconnecting the double frequency generator.

Bc. In machine room install a double frequency motor-generator mounted on shock absorbing base and fastened to floor. Motor shall operate from 115 volts 60 cycle a-c, generator shall have an output of 115 volts 120 cycles a-c and shall have sufficient capacity to supply current to the entire system.

Ca. Install in each room a flush (or surface) synchronous motored a-c clock with two motors having a 12 inch (or 10 or 15 inch) dial in round spun metal case with convex cover glass, complete with backbox. In corridors install a double face wall bracket mounting (or ceiling suspended) clock with 14 inch (or 18 inch) dials in round spun metal case having metal bracket wall supports (or chain supports) with convex cover glasses complete with backbox.

Cb. In supervisor's office install (1) a manual control plate having mounted thereon two tumbler switches, one for control of normal speed motors and one for control of high speed motors, (2) an automatic control panel in flush (or surface) steel cabinet with hinged door equipped with lock and keys. The panel shall contain all control equipment for operating the normal and high speed clock motors.

Da. Install in each room a flush (or surface) synchronous motored a-c clock with single motor and special traingear for changing speed of same. The size of the dial shall be 12 inch (or 10 or 15 inch) and shall be mounted in a round spun metal case with convex cover glass, complete with backbox. In corridors install a double face wall bracket mounting (or ceiling suspended) clock with 14 inch (or 18 inch) dials in round spun metal case having metal bracket wall supports (or chain supports) with convex cover glasses complete with backbox.

Db. In supervisor's office install an automatic clock control panel consisting of selector, relays, timer, rectifier, transformer and terminals enclosed in surface steel cabinet with hinged door equipped with lock and keys.

Ea. Install in each room a flush (or surface) magnet operated secondary clock with 12 inch (or 10 or 15 inch) dial, in round spun metal case with convex cover glass complete with backbox. In corridors install a double face wall bracket mounting (or ceiling suspended) clocks with 14 inch (or 18 inch) dial in round spun metal case with metal bracket supports (or clain supports) with convex cover glasses, complete with backbox.

Eb. In supervisor's office install a master clock with minute impulse 60 beat Graham dead beat escapement movement magnet (or motor) wound, with mercurial (invar or bob) pendulum to keep correct time within 10 seconds (bob 30 seconds) per month, 12 inch dial, relays for each secondary clock circuit of 25, with hourly correction equipment, all enclosed in surface (or flush) wood (or metal) case.

Ec. In machine room install a stable voltage rectifier having an output of 24 volts d-c with current sufficient to operate all clocks on the system.

Fa. Install in each room a flush (or surface) electronic controlled secondary clock complete with receiving and amplifying equipment and synchronous motor movement. Clocks shall have 12 inch (or 15 inch) dials, in metal cases with convex cover glasses complete with backboxes. In corridors install double face bracket mounting (or ceiling suspended) clocks with 15 inch (or 18 inch) dials in metal cases with metal bracket supports (or chain supports) with convex cover glasses, complete with backbox.

Fb. In supervisor's office install a master electronic clock with high-frequency transmitting equipment and selective corrective apparatus to regulate secondary clocks and a synchronous motor for operating the traingear of the clock. This shall be enclosed in a metal case with convex cover glass and 12 inch (or 18 inch) dial.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus ten percent spares. Terminal strips must be mounted on a sheet of insulating material.

Operating Current

The system shall operate from (A,B,C,D,F) directly from 115 volts 60 cycle a-c (E) a stable voltage rectifier power supply having an output of 24 volts d-c, (A,B,C,D,E,F) derived from a separate circuit from the nearest lighting panel. Circuit switch shall be appropriately marked or held to to prevent unnecessary or accidental operation.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wiring to all clocks shall be No. 14 B & S gauge. (A,B,E,F) Two wires are required for the circuits. (CD) Three wires are required for the circuits.

Finish

All wood finishes of master clocks shall match surrounding woodwork. Metal cabinets shall be standard finish (or have prime coat). Clock cases shall be standard finish (or be finished as directed by the Architect).

7.21 NURSES' CALLING SYSTEM

A. Magnetic drop annunciator.
B. Lamp annunciator. (1) Locking button. (2) Pull cord.
C. Emergency. (1) Locking button. (2) Pull cord.
D. Nurse-patient communication. (1) Portable speaker. (2) Wall speaker.
E. Psychiatric.

General

Furnish and install a (trade name and/or number) nurses' calling system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system shall be wired and installed in accordance with the manufacturer's specifications, and left in first class operating condition.

Operation

A. Magnetic drop annunciator system: At each bed there shall be a calling station with portable pushbutton. A patient desiring a nurse shall press the pushbutton which causes an electric reset drop to come into view in the annunciator located at the nurses' station or chart room. At the same time there shall sound momentarily a buzzer in the annunciator. The buzzer may be sounded repeatedly if necessary. The drops remain in view until reset by a pushbutton on the annunciator.

B. Lamp annunciator system: At each bed there shall be a calling station having a (1) detachable plug, cord and locking button, (2) toggle switch with pull cord and pendant. (1, 2,) A patient desiring a nurse shall (1) press the locking button, (2) pull the cord, (1, 2) which causes a lamp signal to light at the following locations: over the patient's room door on corridor side, directional pilots at intersection of corridors, pilots or annunciators in diet kitchens and utility rooms, nurses' station and supervisory office. In addition, stations in wards shall have bullseye lighted on calling station. Simultaneously there shall sound momentarily a buzzer in the pilot stations and annunciators except directional pilots. The buzzer may be sounded repeatedly by the patient if necessary. A cut-off switch shall be provided with each buzzer. All lamp signals shall remain lighted until the call is reset by the nurse at the bedside. (1) Removal of the plug accidentally or otherwise shall light the same lamp signals as if the patient had pressed the calling button, and shall cause the buzzer to sound continuously to signify that the station is out of service. To allow of removal of plugs when desired, the receptacle must also be provided with a switch so that all signals may be cancelled with the plug removed. It shall be impossible to replace plug with the switch in the "off" position.

C. Emergency system: An emergency call shall be added to the standard nurses' calling system by providing a second (1) locking button, (2) toggle switch, (1, 2) on the wall plate of the calling station to summon assistance. By (1) pressing this button, (2) operating this toggle switch, (1, 2) a red lamp shall light at the same points as the standard nurses calling system, and in addition to the clear lamps. A bell shall ring continuously and simultaneously in all pilot stations and annunciators equipped with buzzers. All signals, both bells and lamps shall remain "on" until assistance arrives and the (1) emergency locking button, (2) emergency toggle switch, (1, 2) is reset.

D. Nurse-patient communication: At each single or double bed there shall be an extension of the plate on the nurses' call station which shall contain (1) facilities for a portable speaker-microphone, (1) screened flush speaker-microphone, (1, 2) A patient desiring a nurse shall (1) press the locking button, (2) pull the cord, (1, 2) which causes a lamp signal to light, and buzzers to operate at the same points as the regular calling system, except at the nurses' station annunciator which shall be replaced by a nurses' station control keyboard unit and a power unit with amplifier. The control keyboard shall be provided with two position switches for each pair of rooms, with individual lamp signals for each room, and a molded handphone for conversing with the patient. It shall also be possible for the nurse to listen in on any room for supervisory purposes. A switch shall be provided on each room speaker-microphone to insure privacy when desired.

E. Psychiatric system: At the entrance to each private room, ward and day room, there shall be a wall control station having a cylindrical lock switch. In the private rooms there shall be a wall station with pushbutton. In wards and day rooms there shall be two or more wall stations as shown. By inserting and turning a key in the lock of the corridor station an attendant shall cause a clear lamp to light at the following locations: over the patient's room door corridor side, pilots or annunciators in the diet kitchens and utility rooms, nurses' station and supervisor's office. An attendant may summon assistance by operating a button in the room stations, which shall cause to be lighted a red lamp at all points also equipped with clear lamps. In addition a bell shall ring in all pilot stations and annunciators. All signals, both bells and lamps shall remain "on" until assistance arrives and the wall control station is reset by means of a key.

Equipment

Aa. Install in all private rooms and wards a nurses' calling station consisting of a single gang metal plate with receptacle mounted on a separate yoke and having a detachable two contact plug with a single six foot rubber cord and molded momentary contact pendant pushbutton.

Ab. Install at nurses' station on each floor a flush electric reset drop annunciator with metal trim and hinged door with lock. There shall be contained therein the necessary number of drops for all private rooms and wards on the floor or section. A buzzer shall be provided for an audible signal. A reset button shall be provided on the annunciator for every ten drops.

Ba. Install in all private rooms a nurses' calling station consisting of single gang metal wall plate with (1) receptacle mounted on a separate yoke and having a detachable five way plug with a single cord and molded locking button, (2) toggle switch having five contacts and single pull cord with pendant.

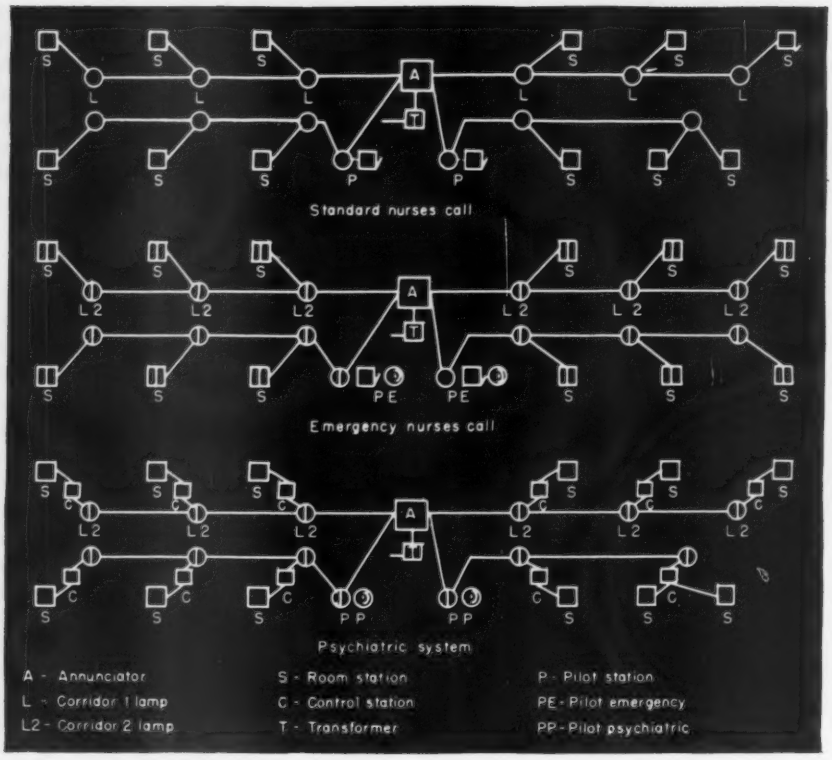
Bb. Install in all semi-private rooms where beds are not adjacent same type of stations specified for the private rooms. Where beds are adjacent provide stations with (1) single plug with two six foot cords and two locking buttons, (2) double pull cords and pendants.

Bc. Install in all wards having three or more beds, stations similar to those specified for the private and semi-private rooms, except that a bullseye complete with lamp and receptacle is to be added.

Bd. Install in all toilets, bathrooms and solariums a wall type cordless station on single gang metal plate.

Be. Install on each open porch or balcony a station similar to that specified for the private rooms except that it shall be weatherproof and be provided with a screw-on cover to cover the receptacle, and a rubber gasket between the station plate and the wall, complete with a cord 15 feet long.

Bf. Install in operating rooms explosion-proof calling stations, consisting of a special cast explosion-proof backbox and cover, with operating mechanism inside of the box. The



Layout nurses call system.

station shall be operated by an exposed plunger on the front of the cover, so arranged that calls may be initiated or cancelled by the foot. Calls from the station shall sound all buzzers continuously in addition to lighting the lamps until the call is cancelled.

Bg. Install in the corridor over the door of each private room and ward, a dome type corridor lamp station. This station shall consist of a two gang metal plate having mounted thereon a translucent plastic dome covering a candelabra base receptacle and lamp. The dome shall be hinged and fastened to the plate by a snap catch.

Bh. Install in the diet kitchens and utility rooms a pilot and buzzer station consisting of a three gang metal plate having mounted thereon a hinged translucent plastic dome similar to the corridor lamp station with the addition of a buzzer and cut-off switch.

Bi. Install in the diet kitchens and utility rooms a bullseye pilot and buzzer station (use in lieu of dome type where sectional indications are desired) consisting of a metal plate having one bullseye indication for each ward on the floor and one common indication for all private rooms. In addition provide a concealed buzzer and a cut-off switch.

Bj. Install at the nurses' station on each floor a flush lamp annunciator with metal trim and hinged door with lock. There shall be contained therein the necessary number of lamps to provide one indication for every private room, ward, solarium and isolated toilet on the floor or section. Annunciator at the floor supervisor's office is to be fully equipped for the entire floor. In addition provide a concealed buzzer with cut-off switch.

Ca. (Add to paragraphs Ba. and Bb.) Emergency (1) calling button shall be added to this same plate and shall be of the five way cordless type, (2) toggle switch shall be placed adjacent to the regular nurses' call toggle switch, and the plate shall be increased to two gangs.

Cb. (Add to paragraph Bc.) Emergency (1) call button shall be placed adjacent to the regular nurses' call station and shall be of the five way cordless type, the plate shall be increased to two gangs, (2) toggle switch shall be placed adjacent to the regular nurses call toggle switch and the plate shall be increased to three gangs.

Cc. (Add to paragraph Bd.) Emergency (1) call button shall be added to the regular nurses' call station and shall be of the five way cordless type, (2) toggle switch shall be placed adjacent to the regular nurses' call toggle switch and the plate shall be increased to two gangs.

Cd. (Add to paragraph Be.) Emergency feature similar to those provided for the toilets, bathrooms and solariums shall be added except that they shall be of the weatherproof type.

Ce. (Add to paragrph Bg.) Emergency red lamp added under dome.

Cf. (Add to paragraph Bh.) Emergency red lamp to be added under dome, and underdome bell to be mounted on plate.

Cf. (Add to paragraph Bi.) Emergency red lamp to be added for each section, and underdome bell to be mounted on plate.

Cg. (Add to paragraph Bj.) Emergency red lamp to be added for each clear lamp, and underdome bell to be enclosed inside annunciator.

Da. (Add to paragraphs Ba. and Bb.) For nurse-patient communication add a four contact polarized molded receptacle on same plate. In addition provide a speaker-microphone of the permanent magnet type (1) in acoustically treated portable cabinet with eight feet rubber cord and a four prong polarized plug, (2) behind an extended grilled plate. Privacy switch shall be mounted on (1) speaker cabinet), (2) speaker plate.

Db. (Add to paragraph Bc.) For nurse-patient communication add to the wards stations the same equipment as for the private room stations.

Dc. (Add to paragraph Bj.) For nurse-patient communication (eliminate lamp annunciator locate at nurses' station a control keyboard consisting of a portable desk unit containing a jewel light for each room station, three-position switching keys for each pair of stations, telephone handset on cradle with press-to-talk switch, terminal strip connected to flexible cable attached to flush wall box with trim, amplifier, power supply unit and directory strip.

Ea. Install in corridor adjacent to private rooms, wards and dayroom doors a wall control station consisting of a two gang metal plate with a multicontact magnetic switch and cylindrical lock mounted on a separate yoke. The lock shall be master-keyed. Fastening screws to be tamper-proof.

Eb. Install inside of each private room a calling station consisting of a single gang metal plate with special momentary contact push button mounted on a separate yoke. Wards and dayrooms to have two or more stations as shown on plans. Fastening screws to be tamper-proof.

Ec. Install in corridor over the door of each private room, ward and dayroom a dome type corridor lamp station. This station shall consist of a two gang metal plate having mounted thereon a translucent plastic dome covering two candelabra base receptacles and two lamps, one red and one clear. The dome shall be hinged and fastened to the plate by a snap catch.

Ed. Install in diet kitchens and utility rooms a pilot and bell station con-

sisting of a metal plate having mounted thereon a hinged translucent plastic dome covering two candelabra base receptacles and two lamps, one red and one clear together with an underdome bell.

Ee. Install in diet kitchens and utility rooms a bullseye pilot and bell station (to be used in lieu of the dome type where desired to have sectional indications instead of one lamp of each color as indications for an entire floor) consisting of a metal plate having two bullseyes, one red and one clear, for each ward and dayroom on the floor, and two similar common bullseyes for all private rooms, together with an underdome bell.

Ef. Install at the nurses' station on each floor a flush lamp annunciator with metal trim and hinged door with lock. There shall be contained therein the necessary number of red and clear lamps for each private room, ward and dayroom on the floor or section. In addition provide a concealed underdome bell.

Terminal Strip Cabinets

Furnish and install where shown on plans, flush steel cabinets with hinged doors equipped with lock and keys. The terminal strips shall have sufficient pairs of terminals for all conductors plus ten percent spares. Terminal strips must be mounted on a sheet of insulating material.

Gang Plates

All nurses' calling system station plates shall be extended to include duplex convenience receptacles, telephone jacks, radio jacks and bedside night light. The outlet boxes shall enclose these outlets and must contain barriers to separate the 115 volt outlets from the other outlets.

Operating Current

The system on each floor shall operate from (A) a transformer having a capacity of 50 watts, (B, C, D, E) a transformer with a capacity of one-half total load, (A, B, C, D, E) primary 115 volts 60 cycle a-c, secondary 24 volts connected on a separate circuit from the nearest lighting panel. It shall be enclosed in a flush ventilated steel cabinet and the secondary shall be properly fused, (B2, C2) 115 volts 60 cycle a-c connected from a separate circuit from the nearest lighting panel.

Wiring

All wiring shall be run in approved conduit in the same manner as for the lighting system. The wires for the signal circuits shall be color coded and rubber covered. (A, B, C, E) Risers and feeders No. 10 B & S gauge. All common wires on each floor or section No. 14 B & S gauge. All buzzer and point wires No. 16 B & S gauge. (B2, C2) All wires on each floor or section No. 14 B & S gauge. (D) All common wires on each floor shall be No. 14 B & S gauge. All common risers and feeders shall be No. 10 B & S gauge. Point wires No. 16 B & S gauge. Communication wires shall be No. 18 B & S gauge rubber covered twisted shielded pair.

Finish

All equipment plates and annunciator trims shall be finished to match hardware or as instructed.

7.22 ROOM AND OFFICE CALL SYSTEMS

A. Office call.
B. Office return-call.

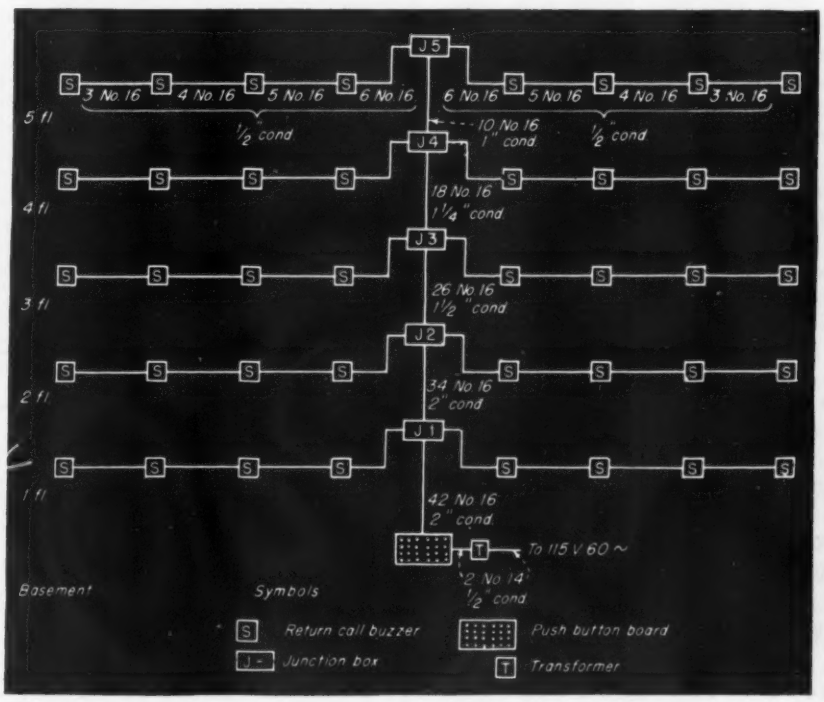
General

Furnish and install a (trade name and/or number) call system as manufactured by (name of manufacturer) and described in these specifications and indicated on wiring plans. The system to be wired and installed in accordance with the manufacturer's specifications and left in first class operating condition.

Operation

A. Office call system: At each location in general office and inside and outside of information office there shall be either a wall or a desk type buzzer as designated. In each private and information office there shall be a desk type pushbutton block with one or more buttons. Pressing a pushbutton in a private office shall sound an associated buzzer in the general office. Pressing of the pushbutton in the information office shall operate the door opener at the main entrance to the general office. Pressing a push button outside of the information office shall sound the buzzer inside of that office. At office boy's desk there shall be an annunciator operated from pushbuttons in various departments as indicated.

B. Office return-call system: At each location in general and in information office there shall be either a wall or a desk type buzzer with pushbutton as designated. In each private office there shall be desk type unit with one or more pushbuttons and a buzzer. On the outside of the information office there shall be a pushbutton. Pressing a pushbutton in a private office shall sound a buzzer at a designated point in the general office. Pressing the pushbutton at the called station shall sound the buzzer at the calling station to indicate that signal has been received. Pressing the pushbutton outside of the information office shall sound the buzzer in that same room, while the pressing of the pushbutton at this point shall operate the door opener at the main entrance to the general office. At office



Riser layout return call system.

boy's desk there shall be a return-call annunciator with an indicating drop and a pushbutton for each department. Pressing a button from a departmental return-call pushbutton and button station will operate a corresponding drop in the annunciator. Pressing the associated pushbutton at the annunciator will sound the buzzer in the calling station.

Equipment

Aa. Install at each wall location a flush non-contact buzzer mounted on a yoke and covered with a single gang metal plate. At desk locations the buzzer shall be of the desk mat type with 6 feet flexible braided cord and terminal block. Pushbutton blocks in private offices shall have required number of pushbuttons and cardholders with 6 feet flexible braided cord and terminal block. Pushbutton outside of information office shall be of the ornamental surface type. Door opener on main door of office shall be of the mortise type and shall be fitted in flush with the door jamb.

Ab. Install at office boy's desk a flush (or surface) wall type electrical reset annunciator having — (name number) drops with necessary collective reset pushbuttons (one for each 10 drops). A buzzer signal shall be enclosed therein. Front shall be hinged and equipped with lock and keys.

Ba. Install at each wall location a flush return-call non-contact buzzer and button mounted on yoke and covered with a single gang metal plate. At desk locations install desk mat with buzzer and buttons and 6 feet flexible braided cord and terminal block. Mats in private offices shall have required number of pushbuttons and cardholders with buzzer and 6 feet flexible braided cord and terminal block. Pushbutton outside of information office shall be of the ornamental surface type. Door opener on main door of office shall be of the mortise type and shall be fitted in flush with the door jamb.

Bb. Install at office boy's desk a flush (or surface) wall type electric reset return-call annunciator having—(name number) drops and pushbuttons with necessary collective reset push buttons (one for each 10 drops). A buzzer signal shall be enclosed therein. Front shall be hinged and equipped with lock and keys.

Terminal Strip Cabinets

Furnish and install where shown on plans flush steel cabinets with hinged doors equipped with lock and keys.

SIGNAL SYSTEM CABLES

Rubber Covered

No. Cond.	No. 18—1/64" R*			No. 18—$\frac{1}{32}$" R			No. 16—1/64" R*			No. 16—$\frac{1}{32}$" R		
	Over. Diam.	Approx. Area Sq. In.	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Conduit Size
10	0.49	0.188	¾"	0.61	0.292	1"	0.53	0.219	1"	0.65	0.330	1"
20	0.63	0.314	1"	0.80	0.503	1¼"	0.69	0.377	1¼"	0.85	0.565	1¼"
30	0.74	0.322	1¼"	0.94	0.691	1½"	0.81	0.518	1¼"	1.01	0.802	1½"
40	0.83	0.541	1¼"	1.06	0.880	2"	0.92	0.668	1½"	1.14	1.021	2"
50	0.93	0.675	1½"	1.18	1.094	2"	1.02	0.817	1½"	1.27	1.254	2"
60	1.00	0.785	1½"	1.28	1.288	2"	1.10	0.950	2"	1.38	1.492	2½"
70	1.10	0.950	2"	1.41	1.563	2½"	1.21	1.147	2"	1.53	1.838	2½"
80	1.15	1.037	2"	1.48	1.720	2½"	1.27	1.254	2"	1.60	2.011	3"
90	1.21	1.147	2"	1.54	1.861	2½"	1.32	1.367	2½"	1.67	2.191	3"
100	1.28	1.288	2"	1.66	2.168	3"	1.41	1.563	2½"	1.79	2.513	3"
125	1.40	1.539	2½"	1.82	2.592	3"	1.56	1.909	2½"	1.96	2.974	3½"
150	1.54	1.861	2½"	1.99	3.110	3½"	1.70	2.260	3"	2.15	3.628	3½"
175	1.66	2.168	3"	2.14	3.596	3½"	1.83	2.631	3"	2.31	4.163	4"
200	1.77	2.458	3"	2.28	4.084	4"	1.95	2.984	3½"	2.47	4.791	4"

* Approved by special permission only.

GROUPED SINGLE CONDUCTORS

Size AWG	Insulation R-32, R, RH, RW*		Insulation TF, T, TW, RU*		Insulation RF-64**		Maximum Number Conductors in Conduit							
	Over. Diam.	Approx. Area Sq. In.	Over. Diam.	Approx. Area Sq. In.	Over. Diam.	Approx. Area Sq. In.	½ in. Int. Area .30 Sq. In.	¾ in. Int. Area .53 Sq. In.	1 in. Int. Area .86 Sq. In.	1¼ in. Int. Area 1.50 Sq. In.	1½ in. Int. Area 2.04 Sq. In.	2 in. Int. Area 3.36 Sq. In.	2½ in. Int. Area 4.79 Sq. In.	3 in. Int. Area 7.38 Sq. In.
18	.146	.0167	.106	.0088			7	12	20	35	49	80	115	176
18					.100	.0079	14	24	42	73	100	165	236	364
16	.158	.0196	.118	.0109			6	10	17	30	41	68	97	150
16					.113	.0100	12	19	33	58	79	131	186	287
14	.171	.0230	.131	.0135			4	6	10	18	25	40	59	90
12	.188	.0278	.148	.0172			3	5	8	15	21	35	50	77
10	.242	.0460	.168	.0224			2	4	7	13	17	29	41	64
8	.311	.0760	.228	.0408			1	3	4	7	10	17	25	38
6	.397	.1238	.323	.0819			1	1	3	4	6	9	15	23

Combination of Conductors

*		**	
1—No. 14 Equal to 2— " " " " 3— " " " " 1— " 12 " " 2— " " " " 3— " " " "	1—No. 18 or 1 No. 16 2— " " " 2 " " 4— " " " 3 " " 1— " " " 1 " " 3— " " " 3 " " 4— " " " 4 " "	3—No. 18 or 2 No. 16 5— " " " 4 " " 8— " " " 7 " " 3— " " " 3 " " 7— " " " 5 " " 10— " " " 8 " "	

Note: * In accordance with NEC.
** Approved by special permission.

[Above sizes apply to straight runs or with nominal offsets equivalent to not more than two quarter-bends

PAGING SYSTEM CABLES

No. Cond.	No. 14—$\frac{1}{64}$" R			No. 12—$\frac{1}{64}$" R			No. 14—$\frac{1}{64}$" RL				No. 12—$\frac{1}{64}$" RL			
	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Cond. Size
12	0.84	0.554	1½"	0.94"	0.680	1½"	0.97"	0.738	$\frac{1}{64}$"	1½"	1.05	0.864	$\frac{1}{64}$"	2"
20	1.10	0.950	2"	1.19"	1.112	2"	1.20"	1.130	$\frac{1}{64}$"	2"	1.32	1.367	$\frac{1}{64}$"	2½"
24	1.21	1.147	2"	1.31"	1.348	2"	1.35"	1.420	$\frac{1}{64}$"	2½"	1.45	1.649	$\frac{1}{64}$"	2½"

SIGNAL SYSTEM CABLES

Rubber and Lead

No. 18—1/64" RL*				No. 18—1/32" RL				No. 16—1/64" RL*				No. 16—1/32" RL			
Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size	Over. Diam.	Approx. Area Sq. In.	Thick Lead	Conduit Size
0.56	0.243	4/64"	1"	0.69	0.377	4/64"	1¼"	0.61	0.292	4/64"	1"	0.73	0.416	4/64"	1¼"
0.70	0.385	4/64"	1¼"	0.90	0.636	5/64"	1½"	0.76	0.454	4/64"	1¼"	0.96	0.723	5/64"	1½"
0.82	0.528	4/64"	1¼"	1.05	0.864	5/64"	2"	0.92	0.665	5/64"	1½"	1.12	0.985	5/64"	2"
0.94	0.680	5/64"	1½"	1.17	1.076	5/64"	2"	1.02	0.817	5/64"	2"	1.28	1.288	6/64"	2"
1.03	0.833	5/64"	2"	1.32	1.367	6/64"	2½"	1.12	0.985	5/64"	2"	1.41	1.563	6/64"	2½"
1.10	0.950	5/64"	2"	1.41	1.563	6/64"	2½"	1.20	1.130	5/64"	2"	1.51	1.791	6/64"	2½"
1.21	1.147	5/64"	2"	1.55	1.885	6/64"	2½"	1.35	1.413	6/64"	2½"	1.66	2.168	6/64"	3"
1.29	1.304	6/64"	2"	1.61	2.035	6/64"	3"	1.40	1.539	6/64"	2½"	1.76	2.435	7/64"	3"
1.33	1.390	6/64"	2½"	1.68	2.199	6/64"	3"	1.46	1.673	6/64"	2½"	1.83	2.631	7/64"	3"
1.42	1.571	6/64"	2½"	1.82	2.592	7/64"	3"	1.55	1.885	6/64"	2½"	1.95	2.985	7/64"	3½"
1.54	1.885	6/64"	2½"	1.98	3.063	7/64"	3½"	1.69	2.246	6/64"	3"	2.12	3.526	7/64"	3½"
1.68	2.199	6/64"	3"	2.15	3.628	7/64"	3½"	1.86	2.717	7/64"	3"	2.34	4.304	8/64"	4"
1.82	2.592	7/64"	3"	2.33	4.265	8/64"	4"	1.99	3.110	7/64"	3½"	2.50	4.909	8/64"	4"
1.93	2.906	7/64"	3"	2.47	4.791	8/64"	4"	2.11	3.495	7/64"	3½"	2.66	5.553	8/64"	4½"

* Approved by special permission only.

Signal and Communication Wiring Data

Wire sizes, dimensions and raceway data for types of conductors commonly used on signal, alarm and communication systems. Systems operating at substantial voltages and currents derived from power or lighting circuits are subject to code rules. On low voltage circuits line drop may also become a critically important consideration.

SINGLE TELEPHONE CABLE

No. Cond.	Single No. 22 & 4 Single No. 18					
	Braided			Leaded		
	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size
6	0.26	0.053	½"	0.30	0.071	½"
11	0.28	0.061	½"	0.33	0.086	½"
16	0.31	0.075	½"	0.36	0.102	½"
26	0.36	0.102	½"	0.40	0.126	¾"
35	0.40	0.126	¾"	0.45	0.159	¾"
45	0.44	0.152	¾"	0.48	0.181	¾"
55	0.46	0.165	¾"	0.51	0.204	¾"
65	0.51	0.204	¾"	0.55	0.236	1"
75	0.53	0.219	1"	0.59	0.255	1"
85	0.55	0.236	1"	0.60	0.283	1"
100	0.60	0.283	1"	0.64	0.322	1"

PAIR TELEPHONE CABLE

No. Pairs	Pairs No. 22 & 2 Pairs No. 18						Pairs No. 22 Only					
	Braided			Leaded			Braided			Leaded		
	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size	Over. Diam.	Approx. Area Sq. In.	Cond. Size
6	0.36	0.102	½"	0.45	0.159	¾"	0.29	0.066	½"	0.33	0.086	½"
12	0.41	0.132	¾"	0.50	0.196	¾"	0.38	0.113	½"	0.42	0.139	¾"
16	0.50	0.196	¾"	0.59	0.273	1"	0.42	0.139	¾"	0.47	0.174	¾"
22	0.57	0.255	1"	0.66	0.342	1"	0.49	0.188	¾"	0.53	0.220	1"
32	0.62	0.302	1"	0.71	0.396	1¼"	0.57	0.253	1"	0.61	0.292	1"
41	0.74	0.430	1¼"	0.85	0.567	1¼"	0.61	0.292	1"	0.66	0.342	1"
51	0.88	0.608	1½"	0.97	0.739	1½"	0.70	0.385	1¼"	0.76	0.454	1¼"
65	0.92	0.665	1½"	1.01	0.802	2"	0.76	0.454	1¼"	0.83	0.541	1¼"
75	0.95	0.709	1½"	1.03	0.833	2"	0.82	0.528	1¼"	0.89	0.622	1½"
85	0.98	0.754	1½"	1.07	0.899	2"	0.86	0.581	1¼"	0.93	0.679	1½"
100	1.08	0.916	2"	1.16	1.057	2"	0.94	0.694	1½"	1.01	0.802	1½"
125	1.18	1.094	2"	1.26	1.247	2"	1.01	0.802	1½"	1.08	0.916	2"
150	1.27	1.254	2"	1.34	1.410	2½"	1.12	0.985	2"	1.18	1.094	2"
175	1.37	1.474	2½"	1.44	1.624	2½"	1.18	1.094	2"	1.25	1.227	2"
200	1.45	1.649	2½"	1.57	1.938	3"	1.27	1.254	2"	1.34	1.410	2½"

DUPLEX & TRIPLEX

Size AWG	Insulation Rubber Braid		Maximum Conductors in Conduit					
	Over. Diam.	Approx. Area Sq. In.	½ in. Int. Area .30 Sq. In.	¾ in. Int. Area .53 Sq. In.	1 in. Int. Area .86 Sq. In.	1¼ in. Int. Area 1.50 Sq. In.	1½ in. Int. Area 2.04 Sq. In.	2 in. Int. Area 3.36 Sq. In
22*	.20	.031	6	12	20	36	50	84
22†	.22	.038	9	15	24	45	60	102
19*	.24	.045	4	8	14	24	34	68
19†	.26	.053	6	9	18	33	45	75

Note: * 2 Wire twisted.
† 3 Wire twisted.

8.1 Lighting

8.11 LIGHTING FIXTURES

Lighting specifications may be drawn around (a) the lighting effect to be accomplished, (b) the kind of lighting components and fixtures to be used, and (c) the specific units to be installed.

The scope of modern lighting practice, and the wide variety of lighting equipments available requires a detailed specification. Detail drawings should be provided with the plans and are essential if the exact make and catalog number are not given as a standard of quality desired.

Furnish and install lighting fixtures, lighting equipment components and lamps for all lighting outlets in the project as shown on plans and listed in the "Schedule of Fixtures," including the connection of the fixtures and equipment to the electric wiring of the building.

Special lighting fixtures and lighting equipment shall be as shown on the drawings.

All lighting fixtures and lighting equipment shall be furnished in strict compliance with the drawings, fixture details and specifications.

All materials and accessories, whether specifically described or not, shall be of the best grade of commercial manufacture and all workmanship shall be first class in every respect.

Models, patterns or photographs of special fixtures shall be submitted for approval when required. Models or patterns shall be corrected and made satisfactory before any work is done on the lighting fixtures.

Fixture parts shall be made of aluminum, brass, bronze, copper, steel or other metal as required and shall be of composition and temper required by the manufacturing processes involved and suitable for the duty or function of the particular fixture part.

In cases where aluminum members are to be fastened to steel or other dissimilar metal parts, the aluminum shall be separated from such parts by a heavy coat of aluminum or bituminous paint to the contact surfaces of the metals and allowed to thoroughly dry before assembly, or by strips of insulation fiber, so placed as to effectively break the contact between them.

Aluminum sheet of less than No. 10 gauge when placed in contact with brick, plastic, gypsum, concrete or similar masonry construction, the aluminum shall be back-painted before installation with the aluminum or bituminous paint.

All burrs, fins and sharp edges must be removed from fixture parts before they are assembled. Canopies, holders, etc., shall be spun or drawn in one piece unless otherwise shown or noted.

The finish of fixtures shall be the manufacturer's standard finish except as otherwise noted on the fixture schedule.

Fixture wire shall be in strict compliance with the latest requirements of the National Board of Fire Underwriters. The carrying capacity of the wire shall meet the latest requirements of the National Electrical Code. No fixture wiring shall be smaller than No. 16 gauge. Wiring shall be protected with tape or tubing at all points where abrasion is liable to occur. All wiring shall be concealed within fixture construction, except where chain suspension is required.

The fixture wiring of chain suspended fixtures shall match the fixture finish. The single wires shall be interlaced in the alternate links of chain. One conductor shall have a continuous identifying marker, readily distinguishing it from the other conductor, the marked conductor to be connected to the screw shell side of the socket or lamp receptacle. Chain suspended -lighting fixture shall be wired with flexible conductors of sufficient length that the weight of the fixture will not put tension on the conductors and there shall be sufficient ends allowed for making connections to the wiring of the building.

No splice or tap shall be located within an arm, stem or chain. Wiring shall be continuous from splice in outlet box on the building wiring system to lampholder or to ballast and from ballast to lampholders.

Fluorescent lighting fixtures shall be of the type, size and quality indicated in the "Schedule of Fixtures", and as shown in detail drawings. Wiring channels and socket mountings shall be rigid, firm and accurately made. Sockets shall hold lamps securely against normal vibration and handling incident to maintenance. Ballasts shall be high power factor type of the best quality and so mounted as to transmit a minimum of hum to the surrounding channel. Connection boxes and wiring channels shall contain only the wires of the connected circuit and shall not be used as junctions or raceways for other circuits unless specially approved for the purpose.

Wherever practical, the components of built-in lighting arrangements shall be standard products of the same manufacturer designed to be assembled and used together without field alterations.

Rows of fixtures, flush, surface or suspended shall be installed accurately on a straight line. Fastenings and suspensions shall be firmly set up so that lines will not be distorted by the handling incident to normal maintenance.

Provisions for maintenance are of the essence of the equipments specified or detailed as standards of quality. All lighting equipments shall be of such design and so installed as to require a minimum of mechanical effort and skill for lamp replacement and cleaning.

All joints in fixture wiring shall be soldered and well insulated with electrical tape. Approved solderless connectors may be used in making connections in the wiring within the fixtures or in connecting the fixture wiring to the wiring of the building.

The dimensions of holders for reflectors or globes shall comply with the dimensions and tolerances required to suit standard fitters, i.e., those commercially referred to by glassware manufacturers as 2¼, 3¼, 4, 6 and 8 inch unless definitely specified to be otherwise.

Silver mirrored glass reflectors shall be of high quality glass, properly annealed, virtually free from color, bubbles and scratches. The reflecting surface shall be pure silver. The reflecting surface shall be protected by a suitable backing which will safeguard it from ordinary atmospheric conditions under temperatures which will prevail when operated with lamps of sizes for which the reflectors are designed. Reflectors shall not mottle, peel, check or tarnish under normal service conditions.

Porcelain enameled steel reflectors specified or indicated by types, shall be of substantially the same contours and dimensions as those commercially known by those designations and as produced under the requirements of the "RLM Standards Institute."

Canopy pull switches: Switches of this type when required, shall be of the single pole, pull type, within canopy or fixture body leaving the switch lever only protruding on exterior of the fixture or shall be inserted in fixture chain by means of a suitable adapter which shall replace one link of chain, the particular mounting to be as required by the contract drawings or specification. The rating of the switches, when in connection with fixtures in which incandescent lamps of 200 watts and larger are to be operated, shall not be less than 10 amperes, T rating, 125 volts 5 amperes,

STANDARD LOADS FOR ILLUMINATION IN COMMERCIAL BUILDINGS

Based upon the use of fluorescent equipment for general lighting, incandescent for supplementary.

Occupancy	Watts per Sq. Ft.
1. Armories	
Drill Sheds and Exhibition Halls This does not include lighting circuits for demonstration booths, special exhibit spaces, etc.	5
2. Art Galleries	
a. General	3
b. On Paintings—50 watts per running foot of usable wall area.	
3. Auditoriums	4
4. Automobile Show Rooms	6
5. Banks	
a. Lobby	4
b. Counters—50 watts per running foot including service for signs and small motor applications, etc.	
c. Offices and Cages	5
6. Barber Shop and Beauty Parlors This does not include circuits for special equipment.	5
7. Billards	
a. General	3
b. Tables—450 watts per table.	
8. Bowling	
a. Alley Runway and Seats	5
b. Pins—300 watts per set of pins.	
9. Churches	
a. Auditoriums	2
b. Sunday School Rooms	5
c. Pulpit or Rostrum	5
10. Club Rooms	
a. Lounge	2
b. Reading Rooms	5
The above two uses are so often combined that the higher figure is advisable. It includes provision for convenience outlets.	
11. Court Rooms	5
12. Dance Halls	2
No allowance has been included for spectacular lighting, spots, etc.	
13. Drafting Rooms	7
14. Fire Engine Houses	2
15. Gymnasiums	
a. Main Floor	5
b. Shower Rooms	2
c. Locker Rooms	2
d. Fencing, Boxing, etc.	5
e. Handball, Squash, etc.	5
16. Halls and Interior Passageways—20 watts per running foot.	
17. Hospitals	
a. Lobby, Reception Room	3
b. Corridors—20 watts per running foot.	
c. Wards	3
Including allowance for convenience outlets for local illumination.	
d. Private Rooms	5
Including allowance for convenience outlets for local illumination.	
e. Operating Room	5
f. Operating Tables or Chairs Major Surgeries—3000 watts per area. Minor Surgeries—1500 watts per area. This and the above figure include allowance for directional control. Special wiring for emergency systems must also be considered.	
g. Laboratories	5
18. Hotels.	
a. Lobby	5
Not including provision for conventions, exhibits.	
b. Dining Room	4
c. Kitchen	5
d. Bed Rooms	3
Including allowance for convenience outlets.	
e. Corridors—20 watts per running foot.	
f. Writing Room	5
Including allowance for convenience outlets.	
19. Library	
a. Reading Rooms	6
This includes allowance for convenience outlets.	
b. Stack Room—12 watts per running foot of facing stacks.	
20. Motion Picture Houses and Theatres	
a. Auditoriums	2
b. Foyer	3
c. Lobby	5
21. Museums	
a. General	3
b. Special exhibits—supplementary lighting	5
22. Office Buildings	
a. Private Offices, no close work	4
b. Private Offices, with close work	5
c. General Offices, no close work	4
d. General Offices, with close work	5
e. File Room, Vault, etc.	3
f. Reception Room	2
23. Post Office	
a. Lobby	3
b. Sorting, Mailing, etc.	5
c. Storage, File Room, etc.	3
24. Professional Offices	
a. Waiting Rooms	3
b. Consultation Rooms	5
c. Operating Offices	7
d. Dental Chairs—600 watts per chair.	
25. Railway	
a. Depot—Waiting Room	3
b. Ticket Offices—General	5
On Counters 50 watts per running foot.	
c. Rest Room, Smoking Room	3
d. Baggage, Checking Office	3
e. Baggage Storage	2
f. Concourse	2
g. Train Platform	2
26. Restaurants, Lunch Rooms and Cafeterias	
a. Dining Areas	3
b. Food Displays—50 watts per running foot of counter (including service aisle.)	
27. Schools	
a. Auditoriums	3
If to be used as a study hall—5 watts per sq. ft.	
b. Class and Study Rooms	5
c. Drawing Room	7
d. Laboratories	5
e. Manual Training	5
f. Sewing Room	7
g. Sight Saving Classes	7
28. Show Cases—25 watts per running foot.	
29. Show Windows	
a. *Large Cities	
Brightly Lighted District—700 watts per running foot of glass.	
Secondary Business Locations—500 watts per running foot of glass.	
Neighborhood Stores—250 watts per running foot of glass.	
b. *Medium Cities	
Brightly Lighted District—500 watts per running foot of glass.	
Neighborhood Stores—250 watts per running foot of glass frontage.	
c. *Small Cities and Towns—300 watts per running foot of glass frontage.	
d. Lighting to Reduce Daylight Window Reflections—1000 watts per running foot of glass.	
*Wattages shown are for white light with incandescent filament lamps. Where color is to be used, wattages should be doubled.	
30. Stores, Large Department and Specialty	
a. Main Floor	6
b. Other Floors	6
31. Stores in Outlying Districts	5
32. Wall Cases—25 watts per running foot.	

250 volts, and for lamps less than 200 watts shall be not less than 6 amperes, 125 volts 3 amperes, 250 volts. A short length of bead chain shall extend from the switch lever with a length of heavy linen cord securely attached thereto and extended from the short length of bead chain, and terminated 6 feet 6 inches above floor with a suitable bell or tassel.

Wireways or wiring channels shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear shall be rounded or bushed in the most suitable manner. Insulated bushings shall be installed at points where flexible wiring enters raceway.

Fluorescent auxiliary equipment: "Ballasts" and "Starter Switches" in connection with fluorescent lighting equipment shall be of the best quality. Unless otherwise required by special fixtures, ballasts having standard cross section dimensions shall be provided. Auxiliary equipment shall be firmly and securely fastened in place.

Fluorescent lampholders shall be of such design that lamps may be inserted or removed easily, but shall hold lamps firmly in place when in use.

High voltage fluorescent: When shown on plans and indicated on the fixture schedule furnish and install the high voltage (cold cathode) fluorescent lighting fixtures and components required.

Fixtures shall be of an approved type designed to meet the latest requirements of the National Electrical Code. Where standard length replaceable tubes are installed the sockets shall be so designed that tubes cannot be removed without opening the primary circuit.

Where tubing is formed and fitted to structural contours, shapes or lengths shall be installed according to the prevailing practice by specially skilled mechanics.

Transformers shall be designed to provide the secondary voltage and milliampere rating necessary for the tube footage and tube diameter installed. Housing shall be of heavy duty type steel. Primary circuit shall be disconnectable by an interlocking safety device, and secondary circuit shall be grounded to the case.

Installation of Lighting Fixtures: All lighting fixtures must be installed by experienced mechanics.

Upon completion of the installation of the lighting fixtures and lighting equipment, they must be in first class operating order and in perfect condition as to finish, etc. At time of final inspection all fixtures and equipment must be complete with the required glassware or reflectors which must be clean and free from defects. Any reflectors or glassware broken prior to the time of final inspection must be replaced.

Tests: After lighting fixtures and lighting equipment are connected to the wiring system of the building or project, the wiring system and the fixtures or equipment must be test free from short circuits and grounds and must show an insulation resistance between conductors and between conductors and ground based on minimum load not less than the requirements of the latest edition of the National Electric Code.

Coordination of work: The furnishing and installation of the lighting fixtures and lighting equipment must be executed in such a manner as to insure its completion coincident with the completion of the construction and mechanical equipment unless otherwise required by the contract specifications.

8.21 STAGE LIGHTING AND CONTROL EQUIPMENT

The following data and specifications are intended to apply only to the stages found in school auditoriums, lodge halls and other assembly halls of small or medium size. Much more elaborate equipment is required in commercial theatres and large auditoriums.

Permanent lighting equipment consists of footlights and borderlights. Both footlights and borderlights are arranged to produce illumination in either white, red or blue or any desired combination of these colors, the total number of lamps being equally divided between the three colors. The better class of equipment is provided with an individual reflector for each lamp, the reflector being fitted with a lens of clear or colored glass termed a "roundel." As compared with the open trough construction and dip-colored lamps formerly used, the individual reflector type is far more efficient and has a much lower maintenance cost. The length of footlights and borderlights should be about 5 ft. less than the width of the proscenium opening.

Footlights: Unless otherwise specified, a footlight is understood to be of the type that is permanently fixed in position. Disappearing footlights are desirable in school and lodge hall auditoriums and other halls where the stage is often used as a lecture platform. When not in use, a hinged cover folds down to cover the opening in the floor and at the same time the footlights automatically lowered and the supply circuits are opened by a switch. Disappearing footlights are regularly made in sections 5 ft. long.

Lamps are spaced approximately 6 in. on centers. A single row of 100 watt lamps is recommended as a minimum. For better lighting, one row of 150 watt lamps may be used, or two rows of 100 watt lamps.

Borderlights: The first borderlights should be located about 2 ft. from the proscenium arch, or as near this position as possible without interfering with other equipment. If two or more borders are installed, the spacing measured on a line from front to back of stage should be about 6 ft. on centers. One borderlight is usually sufficient for a stage 14 ft. deep or less. Two should be provided for depths up to 20 ft., three up to 26 ft. and four up to 32 ft. When the full depth of a stage is to be utilized for scenery, one additional border may be needed in each of the above cases. It is recommended that 100 watt lamps be used as a minimum, with 150 watt or 200 watt lamps for higher lighting intensities. The spacing should be approximately 6 in. on centers for 100 or 150 watt lamps and 8 in. for 200 watts. For installations including two or more borders, one or two independently controlled lamps for use as working lights should be included in at least one of the borders.

All borderlights should be so hung that the angle of light distribution (downward and toward the back of the stage) can be adjusted to secure the best results. Except for the smallest stages, the height of each border from the floor should be adjustable within reasonable limits. Where the height will be such that the borders cannot be reached by means of a stepladder for adjustment, cleaning and replacing lamps, each border should be hung on two or more flexible steel cables passing over sheaves and down to a counterweight at the wall on one side of the stage. Except where a borderlight is permanently secured in position, the necessary number of circuits should be brought to the border in a borderlight cable from a junction box on the stage ceiling. (For a fully-equipped stage the junction boxes must be placed on the gridiron.)

Stage pockets: For the connection of portable lighting equipment, a stage floor pocket should be installed at each side of the stage on a line with each border and 6 ft. from the line of the proscenium opening, measuring away from the center line of the stage. Each pocket should be equipped with two receptacles, one to be wired from the control board on a separate circuit

of No. 12 wire and the other pocket receptacle on a separate circuit of No. 6 wire.

In some cases where the stage is small it may be satisfactory to provide, in place of floor pockets, one or more convenience outlets on each side wall of the stage. These outlets should be provided with duplex receptacles of the split circuit type and each outlet should be wired on a separate three-wire circuit from the control board.

Control: Stage lighting control equipment must be dead front and may be in the form of a panelboard or a switchboard. For small stages the switches on the control board usually control the lighting circuits directly. For a large and well equipped stage the control switches are commonly of the remote control type operated from a pilot board on the stage.

Where the stage is small and the lighting equipment is very simple, a standard lighting panelboard with a switch or circuit breaker for each branch circuit may be satisfactory. If three colors are used, the minimum requirements would be three circuits for the footlights, three circuits for each borderlight and two circuits for each stage floor pocket.

Dimmers: A set of dimmers should be provided in every case where the stage will at times be used for theatrical entertainments. One dimmer unit, operating a separately controlled group of lights would require 12 dimmer units for the footlights and borderlights. The dimmers may also be provided with interlocking equipment and master levers so that all lights of any one color can be dimmed or brightened simultaneously, and various other combinations can be made. Dimmers can also be motor operated and remotely controlled.

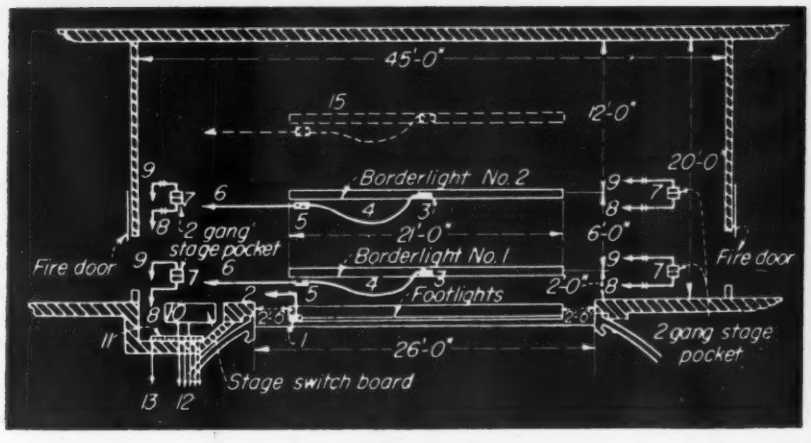
Stage Lighting

Furnish and install stage lighting equipment, stage floor pockets and control board as hereinafter specified complete with all wiring and connections, all to be located as shown on the plans.

Footlights

a-1. Provide a footlight .... ft. long

a-2. Provide a disappearing footlight made up of ..... 5-ft. sections equipped with lampholders and individual reflectors in (one row) (two rows) for a total of ..... watt lamps wired so that lamps are equally divided between three colors. Reflectors shall be equipped with glass roundels, one-third to be clear glass, one-third red and one-third blue. Footlights shall be (mfg. name and catalog number).



Typical small stage layout.

Borderlights

Provide .... borderlights (manufacturer's name and catalog number) each to be .... ft. long and to be equipped with lampholders and individual reflectors for ...., ... watt lamps wired so that lamps are equally divided between three colors. Reflectors shall be equipped with glass roundels, one-third to be clear glass, one-third red and one-third blue. Borderlights shall be hung on steel chains so that the angle of light throw can be adjusted and

a-1. suspended from the stage ceiling so that their height can be adjusted through a range of three feet.

a-2. suspended by means of flexible steel cables passing over sheaves and down to counterweights so arranged that the borders can be lowered to within 6 ft. from the stage floor. A ½-in. hand rope shall be provided for raising and lowering each counterweight. Connections shall be made to each borderlight through a standard borderlight cable containing the necessary number of No. 12 stranded conductors.

Stage Floor Pockets

Install flush in stage floor .... stage floor pockets (manufacturer's name and catalog number), each to have one arc receptacle wired from the stage control board on a separate circuit of two No. 6 wires, and one incandescent receptacle wired on a separate circuit of two No. 12 wires. Furnish.... arc plugs and....incandescent plugs to fit receptacles.

Control Board

All stage and auditorium lighting circuits, except circuits for emergency and exit lighting, shall be controlled at the stage control board.

a-1. Provide a (manufacturer's name and catalog number) panelboard and cabinet with (plug fuses and switches) (circuit-breakers) for the control of .... branch circuits.

a-2. Provide a dead-front stage switchboard with steel plates at ends and top extending to proscenium wall to form a complete enclosure. A door shall be provided at one end for access to the space in the rear of the board. Provide the following control switches and all necessary fuses. All switches shall be of ample rating for the load to be controlled and the rating shall in no case be less than 30 amp.

Control Switches

This list is typical and should be modified as necessary to meet the actual conditions.

1—Stage Master controlling all stage lighting except pockets
1—White Master controlling all white lights
1—Red Master controlling all red lights
1—Blue Master controlling all blue lights

4—White	Foots Border No. 1 Border No. 2 Border No. 3
4—Red	Foots Border No. 1 Border No. 2 Border No. 3
4—Blue	Foots Border No. 1 Border No. 2 Border No. 3

12 for Stage Pockets

1—House Master controlling all auditorium lighting (except emergency and exit lights).

4. Controlling auditorium lighting. (Specify here the switches needed to provide the desired divided control of the auditorium lighting.)

Dimmers

a-1. Install immediately above the

stage control panelboard a bank of dimmers in a metal enclosure with operating levers projecting through the front. One or more sides of the enclosure may be of heavy steel mesh. The enclosure shall be so constructed as to give access to the dimmer plates for servicing or removal and shall be suitably ventilated. Dimmers shall be suitable for continuous duty at any step and shall be (manufacturer's name and type number).
Provide the following dimmer units:

List here the circuits to be provided with dimmers. This arrangement will not be satisfactory if any group of lights to be individually dimmed, such as the white footlights, is controlled by two or more circuit switches.

a-2. Provide as a part of the stage switchboard a bank of dimmers mounted in the switchboard enclosure with operating levers projecting through the face of the board. Dimmers shall be (mfg. name and no.). Provide the following dimmer units.

List here the groups of lights to be provided with dimmers; the common requirements is one dimmer unit for each color in each borderlight and one for each color in the footlights. One or more pocket circuits may also be provided with dimmers. Give details of remote controlled dimmers required and the locations of control points. If interlocking equipment with master levers is required, a manufacturer of such equipment should be consulted before the specifications are written.

9.1 Motors and Controls

9.11 MOTORS

All motors will be (specify single phase, three phase, etc. and voltage) except that motors smaller than ¼ hp. will be single phase, ... volt and shall be of types and speeds as specified in the motor schedule.

Where motors are to be furnished under this contract, each motor shall conform with the NEMA standards for motors of the type and speed specified.

If more than a bare motor is to be furnished, detail specifications should be given for each motor covering the type of base, such as sliding rails, automatic tension adjusting base, etc., and the type of mechanical power transmission equipment, such as belt and pulleys, chain drive, gear drive, coupling for direct connection, etc.

9.21 CONTROLS

This includes only the more common types of general purpose motor control apparatus for alternating current motors and is not intended to cover controllers for multi-speed motors, synchronous motors, elevators or the many special power applications found in industrial plant practice. For all such special applications, detailed specifications for each item of equipment should be obtained from the manufacturers.

Each motor rated at 1/6 hp. or over shall be equipped with a starter or controller which will provide running overcurrent protection for the motor. Overcurrent devices shall open all leads to the motor except that for two-phase motors, only three leads are required to be opened. All starters and controllers shall be enclosed in substantial metal enclosures and shall conform with the NEMA Industrial Control Standards.

Type A starters shall be manually operable by means of a lever, knob or pushbuttons, for full-voltage starting.

Type B starters shall be magnetically operable, for full voltage starting, and shall be provided with undervoltage protection. Provision shall be made for remote control by means of wires leading to other control stations.

Type C starters shall be of the manually operable autotransformer type, for reduced voltage starting. Each starter shall be provided with undervoltage protection and shall have a stop pushbutton in the cover.

Type D starters shall be of the magnetically operated autotransformer type for reduced voltage starting. Each starter shall be provided with undervoltage protection and shall be arranged for remote control.

Type E starters are for use with wound-rotor motors for starting duty only. Each controller shall consist of an assembly of a magnetically-operated primary switch and a resistor switch with suitable resistors. The primary switch shall provide running overcurrent protection and undervoltage protection for the motor. The resistor switch shall be electrically interlocked with the primary switch so that the primary switch cannot be closed unless all resistors are connected. Resistor switches shall be of the dial type for motors of 10 hp. rating or less and shall be of the drum type for larger motors.

Type F controllers are for use with wound-rotor motors for speed regulating duty and shall provide for 50 percent speed reduction and continuous operation at any speed from maximum to minimum. Type F controllers shall in all other respects conform with the specifications for Type E starters.

All control equipment shall be mounted with operating levers or pushbuttons at a height of approximately four feet above the floor. All necessary expansion bolts, brackets and other structural steel parts shall be furnished to provide secure mounting on walls, columns or machine frames as indicated on the plans or, where so indicated, equipment shall be mounted on frames.

Disconnecting means: Where required by the National Electrical Code, a manually operable disconnecting means shall be provided for each motor or for each group of motors driving the several parts of a single machine. Switches and circuit breakers used for this purpose shall be provided with metal enclosures and shall be externally operable and manually operable. The disconnecting means for a permanently installed motor shall be mounted immediately adjacent to, or in the same enclosure with, the motor starter or controller and, if a switch, shall be non-fusible, except that a fusible switch at a distribution center may serve as the disconnecting means if within sight of the motor or if arranged to be locked in the "off" position.

9.31 MOTORS AND CONTROL BY OTHERS

Motors and motor control apparatus shall be furnished and installed complete with all wiring as listed in accordance with other sections of these specifications, control for these motors apparatus will be furnished by others, but shall be installed under this contract.

All wiring and disconnecting means, where required, shall be furnished and installed for motors listed in accordance with other sections of these specifications. Motors and control apparatus will be furnished by others.

9.41 ELECTRONIC CONTROLS

For apparatus shown on plans to

be electronically controlled, furnish and install the controls listed complete with all wiring in operating condition. (List control elements required, for example, light source, photocell pickup, amplifier, relay, controller, etc.) Furnish two copies of wiring diagrams and maintenance instructions. Provide one complete set of replacement tubes.

9.51 FANS

Furnish and install where shown on plans the following built in propeller fans.

On the opening provided by others furnish and install a propeller fan to have a capacity of ..... cubic feet of air per minute, at a speed not exceeding ..... rpm., and with a decibel rating not to exceed ..... The fan wheel shall be dynamically balanced and mounted directly on the motor shaft. The motor shall be dynamically balanced and provided with high quality bearings. The complete fan, including the motor, is to be guaranteed as a unit by the manufacturer who is to assume undivided responsibility.

On the exterior furnish and install a shutter (motor operated, manually operated, automatic) of the following size and type .....

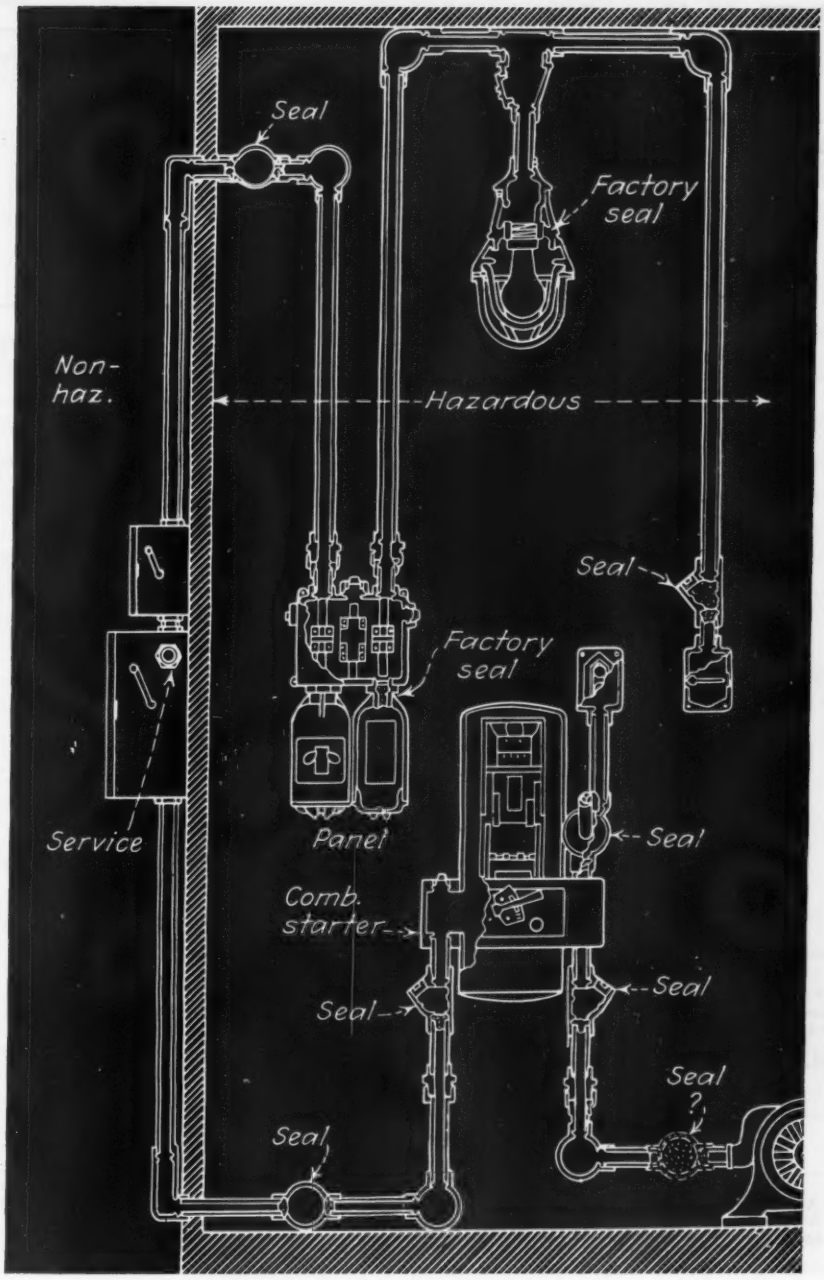
Fan shall be provided with a screen guard of the appropriate size and type. Control shall be provided by means of a switch installed where shown and of the following type and characteristics (state size, catalog number, rating, number of speeds, surface on flush, etc.)

9.61 INBUILT ELECTRIC HEATERS

Furnish and install at the points shown a (manual, thermostat) operated electric heater of .... watts capacity. Heaters shall be flush and approved for the type of use, installation and operation. Heaters shall be as made by ....., catalog No. ..... and shall be installed in the manner recommended by the manufacturer.

9.62 ELECTRIC RADIANT HEATING

The application of resistance wires and panels for space heating large areas at comparatively low temperatures is a developing aspect of electrical utilization. The method offers many advantages and comforts. Provisions for wiring electric radiant heating systems follow generally the wiring for other light and power. The drawings should show the layout and number of panels, the location of outlets and the provisions for control. A typical specification follows:



Typical explosion-proof motor installation.

Radiant Heating

Furnish and install the radiant heating system shown on the plans, completely wired and in operating condition. The panels of the ratings shown shall be installed on the ceiling and fastened as shown (nailed to ceiling joists, etc.)

From junction boxes in the branch circuit extend (armored cable, flexible conduit and wire) to the outlet box on the back of the heat panel or to special molding as directed. Load considerations shall be the same as for lighting circuits and no diversity factor shall be applied.

All fastenings shall be made in the neutral area around the panel. Under no circumstances shall the panels be cut or pierced in the active area. Fastenings shall be flush or countersunk as required for a smooth surface.

Furnish and install low voltage thermostat controls at the points indicated. Thermostats shall be operated on a temperature differential of not more than ½ degree and shall operate their associated heating panels through a relay-transformer located as shown. All controls, relay transformers and thermostats shall be of the best quality and of a type approved by the panel manufacturers for the duty expected.

Panels shall be installed with care, tested and left in full operating condition.

10.1 Data Tables

NUMBER OF COMDUCTORS IN CONDUIT OR TUBING

Rubber Covered, Types RF-32, R, RH, RW and RU
Thermoplastic, Types TF, T and TW
One to Nine Conductors

Size AWG MCM	Number of Conductors in one Conduit or Tubing								
	1	2	3	4	5	6	7	8	9
18	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4
16	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4
14	1/2	1/2	1/2	1/2	3/4	3/4	1	1	1
12	1/2	1/2	1/2	3/4	3/4	1	1	1	1 1/4
10	1/2	3/4	3/4	3/4	1	1	1	1 1/4	1 1/4
8	1/2	3/4	3/4	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2
6	1/2	1	1	1 1/4	1 1/2	1 1/2	2	2	2
4	1/2	1 1/4	*1 1/4	1 1/2	1 1/2	2	2	2	2 1/2
3	3/4	1 1/4	1 1/4	1 1/2	2	2	2	2 1/2	2 1/2
2	3/4	1 1/4	1 1/2	2	2	2	2 1/2	2 1/2	2 1/2
1	3/4	1 1/2	1 1/2	2	2 1/2	2 1/2	2 1/2	3	3
0	1	1 1/2	2	2	2 1/2	2 1/2	3	3	3
00	1	2	2	2 1/2	2 1/2	3	3	3	3 1/2
000	1	2	2	2 1/2	3	3	3	3 1/2	3 1/2
0000	1/4	2	2 1/2	3	3	3	3 1/2	3 1/2	4
250	1 1/4	2 1/2	2 1/2	3	3	3 1/2	4	4	4 1/2
300	1 1/4	2 1/2	2 1/2	3	3 1/2	4	4	4 1/2	4 1/2
350	1 1/4	3	3	3 1/2	3 1/2	4	4 1/2	4 1/2	5
400	1 1/2	3	3	3 1/2	4	4	4 1/2	5	5
500	1 1/2	3	3	3 1/2	4	4 1/2	5	5	6
600	2	3 1/2	3 1/2	4	4 1/2	5	6	6	6
700	2	3 1/2	3 1/2	4 1/2	5	5	6	6	...
750	2	3 1/2	3 1/2	4 1/2	5	6	6	6	...
800	2	3 1/2	4	4 1/2	5	6	6	...	...
900	2	4	4	5	6	6	6	...	...

* Where a service run of conduit or electrical metallic tubing does not exceed 50 feet in length and does not contain more than the equivalent of two quarter bends from end to end two No. 4 insulated and one No. 4 bare conductors may be installed in 1-inch conduit or tubing.

NUMBER OF CONDUCTORS IN CONDUIT OR TUBING

Lead-Covered Types RL and RHL-600 V..

Size AWG MCM	Number of Conductors in One Conduit or Tubing											
	Single Conductor Cable				2-Conductor Cable				3-Conductor Cable			
	1	2	3	4	1	2	3	4	1	2	3	4
14	1/2	3/4	3/4	1	3/4	1	1	1 1/4	3/4	1 1/4	1 1/2	1 1/2
12	1/2	3/4	3/4	1	3/4	1	1 1/4	1 1/4	1	1 1/4	1 1/2	2
10	1/2	3/4	1	1	3/4	1 1/4	1 1/4	1 1/2	1	1 1/2	2	2
8	1/2	1	1 1/4	1 1/2	1	1 1/4	1 1/2	2	1	2	2	2 1/2
6	3/4	1 1/4	1 1/2	1 1/2	1 1/4	1 1/2	2	2 1/2	1 1/4	2 1/2	3	3
4	3/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2 1/2	2 1/2	1 1/2	3	3	3 1/2
3	3/4	1 1/4	1 1/2	2	1 1/4	2	2 1/2	3	1 1/2	3	3	3 1/2
2	1	1 1/4	1 1/2	2	1 1/4	2	2 1/2	3	1 1/2	3	3 1/2	4
1	1	1 1/2	2	2	1 1/2	2 1/2	3	3 1/2	2	3 1/2	4	4 1/2
0	1	2	2	2 1/2	2	2 1/2	3	3 1/2	2	4	4 1/2	5
00	1	2	2	2 1/2	2	3	3 1/2	4	2 1/2	4	4 1/2	5
000	1 1/2	2	2 1/2	2 1/2	2	3	3 1/2	4	2 1/2	4 1/2	4 1/2	6
0000	1 1/4	2 1/2	2 1/2	3	2 1/2	3	3 1/2	4 1/2	3	5	6	6
250	1 1/4	2 1/2	3	3	..	..	..	..	3	6	6	..
300	1 1/2	3	3	3 1/2	..	..	..	..	3 1/2	6	6	..
350	1 1/2	3	3	3 1/2	..	..	..	..	3 1/2	6	6	..
400	1 1/2	3	3	3 1/2	..	..	..	..	3 1/2	6	6	..
500	1 1/2	3	3 1/2	4	..	..	..	..	4	6	..	..
600	2	3 1/2	4	4 1/2	..	..	..	..	..	..	..	..
700	2	4	4	5	..	..	..	..	..	..	..	..
750	2	4	4	5	..	..	..	..	..	..	..	..
800	2	4	4 1/2	5	..	..	..	..	..	..	..	..
900	2 1/2	4	4 1/2	5	..	..	..	..	..	..	..	..

NUMBER OF CONDUCTORS IN CONDUIT OR TUBING

More Than Nine Conductors
Rubber-Covered Types RF-32, R, RH, RW, RU
Thermoplastic Types TF, T, and TW

Size AWG	Maximum Number of Conductors in Conduit or Tubing						
	3/4 Inch	1 Inch	1 1/4 Inch	1 1/2 Inch	2 Inch	2 1/2 Inch	3 Inch
18	12	20	35	49	80	115	176
16	10	17	30	41	68	97	150
14		10	18	25	40	59	90
12			15	21	35	50	77
10			13	17	29	41	64
8				10	17	25	38
6						15	23

DIMENSIONS OF RUBBER-COVERED AND THERMOPLASTIC-COVERED CONDUCTORS

Size AWG MCM	Types RF-32, R, RH, RW		Types TF, T, TW, RU**	
	Approx. Diam. Inches	Approx. Area Sq. Ins.	Approx. Diam. Inches	Approx. Area Sq. Ins.
18	.146	.0167	.106	.0088
16	.158	.0196	.118	.0109
14	2/64 in. .171	.0230	.131	.0135
14	3/64 in. .204*	.0327*		
12	2/64 in. .188	.0278	.148	.0172
12	3/64 in. .221*	.0384*		
10	.242	.0460	.168	.0224
8	.311	.0760	.228	.0408
6	.397	.1238	.323	.0819
4	.452	.1605	.372	.1087
3	.481	.1817	.401	.1263
2	.513	.2067	.433	.1473
1	.588	.2715	.508	.2027
0	.629	.3107	.549	.2367
00	.675	.3578	.595	.2781
000	.727	.4151	.647	.3288
0000	.785	.4840	.705	.3904
250	.868	.5917	.788	.4877
300	.933	.6837	.843	.5581
350	.985	.7620	.895	.6291
400	1.032	.8365	.942	.6969
500	1.119	.9834	1.029	.8316
600	1.233	1.1940	1.143	1.0261
700	1.304	1.3355	1.214	1.1575
750	1.339	1.4082	1.249	1.2252
800	1.372	1.4784	1.282	1.2908
900	1.435	1.6173	1.345	1.4208

* The diameters of Type RW in Nos. 14 and 12 are .204 .221, respectively, and he areas are .0327 and .0384, respectively.
** Type RV conductors recognized in sizes No. 14 to No. 6.
No. 18 to No. 8, solid; No. 6 and larger, stranded.

DIMENSIONS OF LEAD-COVERED CONDUCTORS

Types RL and RHL

Size AWG-MCM	Single Conductor		Two Conductor		Three Conductor	
	Diam. Inches	Area Sq. Ins.	Diam. Inches	Area Sq. Ins.	Diam. Inches	Area Sq. Ins.
14	.28	.062	.28 x .47	.115	.59	.273
12	.29	.066	.31 x .54	.146	.62	.301
10	.35	.096	.35 x .59	.180	.68	.363
8	.41	.132	.41 x .71	.255	.82	.528
6	.49	.188	.49 x .86	.369	.97	.738
4	.55	.237	.54 x .96	.457	1.08	.916
2	.60	.283	.61 x 1.08	.578	1.21	1.146
1	.67	.352	.70 x 1.23	.756	1.38	1.49
0	.71	.396	.74 x 1.32	.859	1.47	1.70
00	.76	.454	.79 x 1.41	.980	1.57	1.94
000	.81	.515	.84 x 1.52	1.123	1.69	2.24
0000	.87	.593	.90 x 1.64	1.302	1.85	2.68
250	.98	.754	.....	....	2.02	3.20
300	1.04	.85	.....	....	2.15	3.62
350	1.10	.95	.....	....	2.26	4.02
400	1.14	1.02	.....	....	2.40	4.52
500	1.23	1.18	.....	....	2.59	5.28

ISOLATION BY ELEVATION

Distance of Live Parts Above the Floor or Other Working Surface

Voltage Between Phases	Minimum Vertical Clearance of Unguarded Parts Feet	Inches
600	8	0
2300	8	0
6600	8	0
11000	9	0
22000	9	3
33000	9	6
44000	9	10
66000	10	5
88000	11	0
110000	11	7
132000	12	2

WORKING SPACE

Minimum Clear Space Adjacent to Live Parts

Voltage Between Phases	Minimum Horizontal Clearance of Unguarded Parts Feet	Inches
600	3	2
2300	3	3
6600	3	4
11000	3	6
22000	3	9
33000	4	0
44000	4	4
66000	4	11
88000	5	6
110000	6	1
132000	6	8

MAXIMUM NUMBER OF CONDUCTORS IN BOXES

Deep Boxes

Box Dimensions Trade Size	Maximum Number of Conductors No. 14	No. 12	No. 10	No. 8
1-1/2 x 3-1/4 octagonal	5	5	4	0
1-1/2 x 4 octagonal	8	7	6	5
1-1/2 x 4 square	11	9	7	5
1-1/2 x 4-11/16 square	16	12	10	8
2-1/8 x 4-11/16 square	20	16	12	10
2 x 1-3/4 x 2-3/4	5	4	4	
2-1/2 x 1-3/4 x 2-3/4	6	6	5	
3 x 1-3/4 x 2-3/4	7	7	6	

Shallow Boxes of Less Than 1½" Depth

Box Dimensions Trade Size	Maximum Number of Conductors No. 14	No. 12	No. 10
3-1/4	4	4	3
4	6	6	4
4-11/16	8	6	6

Combinations

Size of Conductor	Free Space Within Box For Each Conductor
No. 14	2. cubic inches
No. 12	2.25 cubic inches
No. 10	2.5 cubic inches
No. 8	3. cubic inches

FULL-LOAD CURRENT*

Direct-Current Motors

HP	115V	230V	550V
½	4.6	2.3	.....
¾	6.6	3.3	1.4
1	8.6	4.3	1.8
1½	12.6	6.3	2.6
2	16.4	8.2	3.4
3	24.	12.	5.0
5	40	20.	8.3
7½	58	29.	12.0
10	76.	38	16.0
15	112	56	23.0
20	148	74	31.
25	184	92	38.
30	220	110	46.
40	292	146	61
50	360	180	75
60	430	215	90
75	536	268	111
100		355	148.

* These values for full-load current are average for all speeds.

FULL-LOAD CURRENT*

Single-Phase A-C Motors

HP	115V	230V	440V
1/6	3.2	1.6	
¼	4.6	2.3	
½	7.4	3.7	
¾	10.2	5.1	
1	13.	6.5	
1½	18.4	9.2	
2	24.	12.	
3	34.	17.	
5	56.	28.	
7½	80.	40.	21.
10	100.	50.	26.

FULL-LOAD CURRENT*

Three-Phase A-C. Motors

HP	Induction Type Squirrel-Cage and Wound Rotor Amperes 110V	220V	440V	550V	2300V	Synchronous Type †Unity Power Facto Amperes 220V	440V	550V	2300V
½	4	2	1	.8	—	—	—	—	—
¾	5.6	2.8	1.4	1.1	—	—	—	—	—
1	7	3.5	1.8	1.4	—	—	—	—	—
1½	10	5	2.5	2.0	—	—	—	—	—
2	13	6.5	3.3	2.6	—	—	—	—	—
3	—	9	4.5	4	—	—	—	—	—
5	—	15	7.5	6	—	—	—	—	—
7½	—	22	11	9	—	—	—	—	—
10	—	27	14	11	—	—	—	—	—
15	—	40	20	16	—	—	—	—	—
20	—	52	26	21	—	—	—	—	—
25	—	64	32	26	7	54	27	22	5.4
30	—	78	39	31	8.5	65	33	26	6.5
40	—	104	52	41	10.5	86	43	35	8
50	—	125	63	50	13	108	54	44	10
60	—	150	75	60	16	128	64	51	12
75	—	185	93	74	19	161	81	65	15
100	—	246	123	98	25	211	106	85	20
125	—	310	155	124	31	264	132	106	25
150	—	360	180	144	37	—	158	127	30
200	—	480	240	192	49	—	210	168	40

For full-load currents of 208 and 200 volt motors, increase the corresponding 220-volt motor full-load current by 6 and 10 per cent, respectively.

* These values of full-load current are for motors running at speeds usual for belted motors and motors with normal torque characteristics. Motors built for especially low speeds or high torques may require more running current, in which case the nameplate current rating should be used.

† For 90 and 80 per cent P. F. the above figure should be multiplied by 1. 1 and 1.25 respectively.

COMBINATION OF CONDUCTORS

Per Cent Area of Conduit or Tubing Occupied by Conductors

	Number of Conductors				
	1	2	3	4	Over 4
Conductors (not lead covered)	53	31	43	40	40
Lead-covered conductors	55	30	40	38	35
For rewiring existing raceways for increased load where it is impracticable to increase the size of the raceway due to structural conditions	60	40	50	50	50

DIMENSIONS OF CONDUIT OR TUBING

Size	Internal Diameter Inches	Area Square Inches	Size	Internal Diameter Inches	Area Square Inches
½	.622	.30	3	3.068	7.38
¾	.824	.53	3½	3.548	9.90
1	1.049	.86	4	4.026	12.72
1¼	1.380	1.50	4½	4.506	15.95
1½	1.610	2.04	5	5.047	20.00
2	2.067	3.36	6	6.065	28.89
2½	2.469	4.79			

ALLOWABLE CURRENT-CARRYING CAPACITIES OF CONDUCTORS IN AMPERES

Not More Than Three Conductors in Raceway or Cable

(Based on Room Temperature of 30 C. 86 F.)

Size AWG MCM	Rubber Type R Type RW Type RU (14-6) Thermoplastic Type T (14-410) Type TW (14-410)	Rubber Type RH	Paper Thermoplastic Asbestos Type TA Var-Cam Type V Asbestos Var-Cam Type AVB	Asbestos Var-Cam Type AVA Type AVL	Impregnated Asbestos Type AI (14-8) Type AIA	Asbestos Type A (14-8) Type AA
14	15	15	25	30	30	30
12	20	20	30	35	40	40
10	30	30	40	45	50	55
8	40	45	50	60	65	70
6	55	65	70	80	85	95
4	70	85	90	105	115	120
3	80	100	105	120	130	145
2	95	115	120	135	145	165
1	110	130	140	160	170	190
0	125	150	155	190	200	225
00	145	175	185	215	230	250
000	165	200	210	245	265	285
0000	195	230	235	275	310	340
250	215	255	270	315	335	....
300	240	285	300	345	380	....
350	260	310	325	390	420	....
400	280	335	360	420	450	....
500	320	380	405	470	500	....
600	355	420	455	525	545	....
700	385	460	490	560	600	....
750	400	475	500	580	620	....
800	410	490	515	600	640	....
900	435	520	555	...	...	....
1000	455	545	585	680	730	....
1250	495	590	645	...	...	....
1500	520	625	700	785	...	....
1750	545	650	735	...	...	....
2000	560	665	775	840	...	....

CORRECTION FACTOR FOR ROOM TEMPERATURES OVER 30 C. 86 F.

C.	F.						
40	104	.82	.88	.90	.94	.95	....
45	113	.71	.82	.85	.90	.92	....
50	122	.58	.75	.80	.87	.89	....
55	131	.41	.67	.74	.83	.86	....
60	140	....	.58	.67	.79	.83	.91
70	158	....	.35	.52	.71	.76	.87
75	167	....	...	.43	.66	.72	.86
80	176	....	...	.30	.61	.69	.84
90	194	....	...	....	.50	.61	.80
100	212	....	...	....	...	.51	.77
120	248	....	...	....	...	...	.69
140	284	....	...	....	...	...	.59

ALLOWABLE CURRENT-CARRYING CAPACITIES OF CONDUCTORS IN AMPERES

Single Conductor in Free Air

(Based on Room Temperature of 30 C. 86 F.)

Size AWG MCM	Rubber Type R Type RW Type RU (14-6) Thermoplastic Type T Type TW	Rubber Type RH	Thermoplastic Asbestos Type TA Var-Cam Type V Asbestos Var-Cam Type AVB	Asbestos Var-Cam Type AVA Type AVL	Impregnated Asbestos Type AI (14-8) Type AIA	Asbestos Type A (14-8) Type AA	Slow Burning Type SB Weatherproof Type WP Type SBW
14	20	20	30	40	40	45	30
12	25	25	40	50	50	55	40
10	40	40	55	65	70	75	55
8	55	65	70	85	90	100	70
6	80	95	100	120	125	135	100
4	105	125	135	160	170	180	130
3	120	145	155	180	195	210	150
2	140	170	180	210	225	240	175
1	165	195	210	245	265	280	205
0	195	230	245	285	305	325	235
00	225	265	285	330	355	370	275
000	260	310	330	385	410	430	320
0000	300	360	385	445	475	510	370
250	340	405	425	495	530	....	410
300	375	445	480	555	590	....	460
350	420	505	530	610	655	....	510
400	455	545	575	665	710	....	555
500	515	620	660	765	815	....	630
600	575	690	740	855	910	....	710
700	630	755	815	940	1005	....	780
750	655	785	845	980	1045	....	810
800	680	815	880	1020	1085	....	845
900	730	870	940	....	.....	....	905
1000	780	935	1000	1165	1240	....	965
1250	890	1065	1130	....	.....	.....	.....
1500	980	1175	1260	1450	.....	....	1215
1750	1070	1280	1370	....	.....	.....	.....
2000	1155	1385	1470	1715	.....	....	1405

CORRECTION FACTOR FOR ROOM TEMPERATURES OVER 30 C. 86 F.

C.	F.							
40	104	.82	.88	.90	.94	.95	....	.....
45	113	.71	.82	.85	.90	.92	....	.....
50	122	.58	.75	.80	.87	.89	....	.....
55	131	.41	.67	.74	.83	.86	....	.....
60	140	.....	.58	.67	.79	.83	.91	.....
70	158	.....	.35	.52	.71	.76	.87	.....
75	167	.....	....	.43	.66	.72	.86	.....
80	176	.....	....	.30	.61	.69	.84	.....
90	194	.....	....	.....	.50	.61	.80	.....
100	212	.....	....	.....	....	.51	.77	.....
120	248	.....	....	.....	....	.....	.69	.....
140	284	.....	....	.....	....	.....	.59	.....

CONDUCTOR SIZES AND OVERCURRENT PROTECTION FOR MOTORS

The values shown for running protection in Columns 5 and 6 must be modified if nameplate full load current values are different. Conductor sizes shown in Columns 2 and 3 may be smaller for certain motors. The current values shown in Columns 5 and 6 must be reduced by 8 per cent for all motors other than open type motors marked to have a temperature rise not over 40 degrees C.

Full load current rating of motor amperes	Minimum size conductor in raceways For conductors in air or for other insulations see tables 1 and 2 AWG and MCM Type R		For Running Protection of Motors		Maximum Allowable Rating or Setting of Branch Circuit Protective Devices			
	Type T	Type RH	Maximum rating of non-adjustable protective devices	Maximum setting of adjustable protective device	**With Code Letters** Single-phase and squirrel cage and synchronous. Full voltage, resistor and reactor starting, Code letters F to R inc. **Without Code Letters** Same as above.	**With Code Letters** Single-phase and squirrel cage and synchronous. Full voltage, resistor or reactor starting, Code letters B to E inc. Auto-transformer starting, Code letters F to R inc. **Without Code Letters** Squirrel cage and synchronous, auto-transformer starting, High reactance squirrel cage. Both not more than 30 amperes	**With Code Letters** Squirrel cage and synchronous Auto-transformer starting, Code letters B to E inc. **Without Code Letters** Squirrel cage and synchronous, auto-transformer starting, High reactance squirrel cage Both more than 30 amperes	**With Code Letters** All motors. Code letter A. **Without Code Letters** DC and wound-rotor motors
Col. No. 1	2	3	Amperes 5	Amperes 6	7	8	9	10
1	14	14	2	1.25	15	15	15	15
2	14	14	3	2.50	15	15	15	15
3	14	14	4	3.75	15	15	15	15
4	14	14	6	5.0	15	15	15	15
5	14	14	8	6.25	15	15	15	15
6	14	14	8	7.50	20	15	15	15
7	14	14	10	8.75	25	20	15	15
8	14	14	10	10.0	25	20	20	15
9	14	14	12	11.25	30	25	20	15
10	14	14	15	12.50	30	25	20	15
11	14	14	15	13.75	35	30	25	20
12	14	14	15	15.00	40	30	25	20
13	12	12	20	16.25	40	35	30	20
14	12	12	20	17.50	45	35	30	25
15	12	12	20	18.75	45	40	30	25
16	12	12	20	20.00	50	40	35	25
17	10	10	25	21.25	60	45	35	30
18	10	10	25	22.50	60	45	40	30
19	10	10	25	23.75	60	50	40	30
20	10	10	25	25.0	60	50	40	30
22	10	10	30	27.50	70	60	45	35
24	10	10	30	30.00	80	60	50	40
26	8	10	35	32.50	80	70	60	40
28	8	10	35	35.00	90	70	60	45
30	8	8	40	37.50	90	70	60	45
32	8	8	40	40.00	100	80	70	50
34	6	8	45	42.50	110	90	70	60
36	6	8	45	45.00	110	90	80	60
38	6	6	50	47.50	125	100	80	60
40	6	6	50	50.00	125	100	80	60
42	6	6	50	52.50	125	110	90	70
44	6	6	60	55.0	125	110	90	70
46	4	6	60	57.50	150	125	100	70
48	4	6	60	60.0	150	125	100	80
50	4	6	60	62.50	150	125	100	80
52	4	6	70	65.0	175	150	110	80
54	4	4	70	67.50	175	150	110	90
56	4	4	70	70.00	175	150	120	90
58	3	4	70	72.50	175	150	120	90
60	3	4	80	75.00	200	150	120	90
62	3	4	80	77.50	200	175	125	100
64	3	4	80	80.00	200	175	150	100
66	2	4	80	82.50	200	175	150	100
68	2	4	90	85.00	225	175	150	110
70	2	3	90	87.50	225	175	150	110
72	2	3	90	90.00	225	200	150	110
74	2	3	90	92.50	225	200	150	125
76	2	3	100	95.00	250	200	175	125
78	1	3	100	97.50	250	200	175	125
80	1	3	100	100.00	250	200	175	125
82	1	2	110	102.50	250	225	175	125
84	1	2	110	105.00	250	225	175	150
86	1	2	110	107.50	300	225	175	150
88	1	2	110	110.00	300	225	200	150
90	0	2	110	112.50	300	225	200	150
92	0	2	125	115.00	300	250	200	150
94	0	1	125	117.50	300	250	200	150
96	0	1	125	120.00	300	250	200	150
98	0	1	125	122.50	300	250	200	150
100	0	1	125	125.00	300	250	200	150
105	00	1	150	131.5	350	300	225	175
110	00	0	150	137.5	350	300	225	175
115	00	0	150	144.0	350	300	250	175
120	000	0	150	150.0	400	300	250	200
125	000	00	175	156.5	400	350	250	200
130	000	00	175	162.5	400	350	300	200
135	0000	00	175	169.0	450	350	300	225
140	0000	00	175	175.0	450	350	300	225
145	0000	000	200	181.5	450	400	300	225
150	0000	000	200	187.5	450	400	300	225
155	0000	000	200	194.0	500	400	350	250
160	250	000	200	200.0	500	400	350	250
165	250	0000	225	206.	500	450	350	250
170	250	0000	225	213.	500	450	350	300
175	300	0000	225	219.	600	450	350	300
180	300	0000	225	225.	600	450	400	300
185	300	0000	250	231.	600	500	400	300
190	300	250	250	238.	600	500	400	300
195	350	250	250	244.	600	500	400	300
200	350	250	250	250.	600	500	400	300
210	400	300	250	263.	....	600	450	350
220	400	300	300	275.	....	600	450	350
230	500	300	300	288.	....	600	500	350
240	500	350	300	300.	....	600	500	400

POWER LOAD DATA

Appliance, Device or Machine	Domestic		Commercial—Industrial	
	Watts	Horsepower	Watts	Horsepower
	From To	From To	From To	From To
LIGHTING EQUIPMENT				
Airport Floods			240–3000	
Airport Landing Lights			to 1 Kw.	
Aisle and Seat Floods			25–60	
Blue Printing			3–10 Kw.	
Borderlights, Prof. Stage, per ft.			200–2000	
Borderlights, Schools, per ft.			100–500	
Cove, Strips, per ft.	20–200		20–500	
Exit Signs			40–150	
Floodlights, Outdoor	60–500		200–2000	
Floodlights, Window			100–1000	
Fluorescent lamps, per ft.	10–25		10–25	
Footlights, Prof. Stage, per ft.			100–1000	
Footlights, Schools, per ft.			100–300	
Infrared lamps, per lamp	100–300		250–1000	
Luminaires (Commercial Lighting Fixtures)			100-up	
Luminous Tubing (Cold Cathode) per ft			8–20	
Operating Rooms (Hospital)			1–10 Kw.	
Photostat Machines			1–5 Kw.	
Projectors, Amateur Movie	500–750			
Projectors, Amateur Movie and Sound	650–1250			
Projectors, Prof. Movie			1500–3500	1/4–1
Projectors, Visual Lecturing			400–1000	
Reflectors, Show Case, per ft.			30–150	
Reflectors, Show Window, per ft.			100–750	
Spotlights Ball Room	100–500		100–2000	
Spotlights Projection Booth			2750–3300	
Spotlights Stage or Balcony Rail			200–1500	
Spotlights Show Windows			100–1000	
Spotlights Statuary (Residence)	25–300			
Sterilamps, per ft.	10–30		10–30	
Vapor, Mercury, High Intensity			250–3000	
Vapor, Sodium			to–180	
ELECTRICALLY HEATED EQUIPMENT				
Blankets	50–100			
Casseroles	100–425			
Cookers, Food	125–1000			
Dishes, Chafing	160–660			
Driers, Clothes	350–5000	1/4	350–5000	1/2
Driers, Hair	200–550		300–1200	
Fireplaces, Artificial	1–2 Kw.		1–2 Kw.	
Friers, Deep Fat			1–2 Kw.	
Heaters, Air	.4–9 Kw.		.4–9 Kw.	
Heaters, Aquarium	50–100			
Heaters, Chick Brooder	1–5 Kw.			
Heaters, Chick Hatchery	1–20 Kw.			
Heaters, Curling Iron			450–750	
Heaters, Immersion Type	150–1000		200–2500	
Heaters, Organ Chamber	1–3 Kw.		2–10 Kw.	
Heaters, Permanent Wave Mach			2–4 Kw.	
Heaters, panel per sq. ft.	17–50		17–50	
Heaters, Soil per 60-ft. & 120-ft. Lengths	400–800			
Heaters, Space Elements			1–3 Kw.	
Heaters, Tank Type Water	1–5 Kw.		1–5 Kw.	
Humidifiers, Portable Room		1/100–1/20		

Appliance, Device or Machine	Domestic		Commercial—Industrial	
	Watts	Horsepower	Watts	Horsepower
	From To	From To	From To	From To
Elevators 10 Pass				7½–20
Elevators 25 Pass				10–50
Escalators				10–40
Exercisers		1/6–1/4		1/6–1/4
Extractors Juice		1/10–1/4		1/10–1/4
Extractors Steam Laundry				5–20
Fans Bracket & Desk	30–100		30–100	
Fans Ceiling	80–125		80–125	
Fans Pedestal	125–300		125–300	
Fans Ventilating 10-in.	35–45		35–45	
Fans Ventilating 12-24 in.		1/40–1/4		1/40–1/4
Fans Ventilating 30-in. & up				3/8–3
Flasher, Sign Switch Drive				1/20–1/4
Freezing Food	3–5 Kw.		3–20 Kw.	
Freezers, Ice Cream		1/20–1/4		
Grinders, Coffee (Stores)				1/6–3/4
Grinders, Meat		1/20–1/4		1/4–1
Grinders, Refuse		to–1/4		
Hoists, Ash & Cinder				1–5
Hoists, Tramrail 1-ton				1½–3
Hoists, Tramrail 5-ton				6–10
Hoists, Warehouse Loading				1–3
Lathes, Home Shop		1/8–1/2		
Machines (Floor) Sanding		1/7–1/2		1–3
Machines (Floor) Terrazzo		1/7–1/2		1–5
Machines (Floor) Waxing		1/7–1/2		1/4–1
Machines Sewing		1/50–1/20		1/4–2
Machines Office, Adding				1/20–1/10
Machines Office, Addressing				1/8–1/3
Machines Office, Billing				1/10–1/2
Machines Office, Bookkeeping				1/10–1/2
Machines Office, Computing				1/10–1/4
Machines Office, Dictation				–1/30
Machines Office, Record Shaving				–1/20
Machines Office, Sealing & Stamping				1/10–1/6
Machines Office, Typewriters				1/30–1/10
Mangles, Steam Laundry				7½–20
Mixers, Beverage	30–90		30–100	
Mixers, Dough		1/10–1/4		5–20
Mixers, Food		1/10–1/4		1/6–2
Mowers, Lawn		1/3–1/2		1/3–1
Musical Instruments, Phonograph	50–200	1/20–1/8	50–200	1/20–1/4
Pumps, Boiler Feed				1–5
Pumps, Brine				2–20
Pumps, Drinking Water Circ.				1/2–5
Pumps, Fire Protection				20–150
Pumps, Fuel		1/8–1		1/4–3
Pumps, Household Water		1/6–1		
Pumps, Milking Machines				1/2–2
Pumps, Pool & Illum. Fountain				1/4–5
Pumps, Roof Storage Tank				7½–25
Pumps, Sump				1/4–3
Pumps, Vacuum				2–5
Razors, Electric	6–15			
Refrigerators		1/8–1/3		1/3–2
Saws, Band (Home Work Shop)		1/4–1/2		
Saws, Circular	15–30		15–30	

Heaters, Soil per 60-ft. & 120-ft. Lengths	400–800		1–3 Kw.	
Heaters, Space Elements				
Heaters, Tank Type Water	1–5 Kw.		1–5 Kw.	
Humidifiers, Portable Room		1/100–1/20		
Ironers, Clothes	1200–3300	1/20–1/4		
Irons, Flat	500–1200		500–2500	
Irons, Soldering	60–500		200–400	
Irons, Waffle	300–1320		1–3 Kw.	
Lamps, Health and Sun	30–1500		250–1500	
Lighters, Cigarette & Cigar	–75		–75	
Machines Vending			100–1000	
Machines, Pop Corn			3–6 Kw.	
Makers, Coffee	450–750		1–6 Kw.	
Ovens, Baking & Roasting	660–2400		5–15 Kw.	
Ovens, Bread & Pie			12–55 Kw.	
Ovens, Industrial Annealing			5–30 Kw.	
Ovens, Industrial Enamelling			10–100 Kw.	
Pads Heating	50–60		50–60	
Percolators	300–450			
Plates, Hot, Grills, Griddle Table Stoves	480–6000		1–6 Kw.	
Poppers, Corn	450–660			
Pots, Glue			100–1500	
Pressers, Trousers & Tie	37–500		500–1500	
Ranges	5–15 Kw.		8–25 Kw.	
Roaster	1–2 Kw.			
Sterilizers, Dental & Doctor			1000–3000	
Toasters, Bread & Sandwich	420–1400		2–5.5 Kw.	
Toys, Electric	50–1175			
Waffle Iron	1–2 Kw.		2–6 Kw.	
Warmers, Bottle	300–600			
Warmers, Cafeteria Food			4–6 Kw.	
Warmers, Plate	110–500		1–2 Kw.	
Warmers, Soup & Seafood			450–1000	
Vaporizers, Medicated Solution	75–330			
MOTOR-OPERATED EQUIPMENT				
Air Conditioning Systems		1/4–1/2		1/2–up
Automatic Heating Equipment		1/8–1/2		1/4–10
Blowers, Organ		1–3		2–7½
Blowers, Pneumatic Tube Systems				10–30
Blowers, Portable Cleaning				1/6–3
Cash Registers				1/20–1/8
Churns, Butter		1/8–1/2		
Cleaners, Vacuum Built-in		1/2–5		1–7½
Cleaners, Vacuum Portable		1/30–1/4		
Clippers, Hedge		1/30–1/4		
Clocks, Motor Operated				1/50–1/4
Compressors, Air (Gasoline Station)				1–5
Compressors, Air (Temp. Regul. System)		1/4–2		1/2–3
Compressors, Refrigeration				5–5000
Conditioners, Air (Room Type)		1/100–5		1/4–5
Coolers, Water		1/8–1/3		1/8–1/3
Cranes, Travelling Lift				5–30
Cranes, Travelling Bridge				1
Dimmer Lever Drives				½–1½
Dental Chair Units			500–1500	
Disposal Units (Garbage)		1/3–		
Door Openers, Private Garage		1/8–1		
Door Openers, Commercial				1/4–5
Drills, Portable 1/8 to 1/2-in.				1/6–1/4
Drills, Portable 5/8 & Larger				1/4–1
Dumbwaiters				1/2–5
Elevators, 1-Ton Freight				3–10
Elevators 5-Ton Freight				7½–20
Pumps, Sump				1/4–3
Pumps, Vacuum				2–5
Razors, Electric	6–15			
Refrigerators		1/8–1/3		1/3–2
Saws, Band (Home Work Shop)		1/4–1/2		
Sharpeners, Razor Blade	15–30		15–30	
Softeners, Water		1/12–1/8		
Sprayers, Paint & Insecticide		1/20–1/6		
Stage, Curtain Control Motor				1/4–1
Stage, Orchestra Lift				15–25
Stage, Organ Lift				3–7½
Stokers, Coal		1/6–1/3		1/2–5
Trains, Toy	40–100			
Tumblers, Laundry Drying				3–10
Vibrators, Massage		1/50–1/20		1/20–1/8
Washers, Clothes		1/8–1/4		
Washers, Dish		1/8–1/4		1/2–5
Washers, Steam Laundry				3–15
MAGNETS, RECTIFIERS, TRANSFORMERS				
Chargers, Battery	600–750		1–15 Kw.	
Closers, Window/ Magnetic	500–1000			
Diatherm, Therapeutic			250–750	
Door Locks, Apt. House	6–9			
Electroplating			5–20 Kw.	
Furnaces, Induction			5–500 Kw.	
Magnets, Lifting Metal			4–15 Kw.	
Magnets, Metal Extracting			1½–5 Kw.	
Ozonators, Room Air Purific			.5–3 Kw.	
School Laboratory Panel			5–50 Kw.	
Transformers, Bell Ringing	25–50			
Transformers, Signal Systems			50–500	
Valves, Gas & Liquids, 1-in. & Less			200–1000	
Valves, Above 1-in.			500–3000	
Welders, Light Duty Spot & Arc			3–20 Kw.	
Welders, Heavy Duty & Arc			20–100 Kw.	
X-Ray—Dental & Doctor			2–25 Kw.	
X-Ray Hospital			10–40 Kw.	
COMMUNICATIONS AND SIGNALLING EQUIPMENT				
Airport Communications			500–5000	
Alarms, Burglar	10–60		100–1000	
Alarms, Fire	10–60		100–1000	
Amplifiers, Radio Distribution			200–1000	
Annunicators, Home 5/8- to 2½-in. Lamps, Each	1.8–2.4			
Annunciators, Large Systems—(110-Volt Lamps, Each)	–10		–10	
Bells, 2½-in. to 4-in.	5–10		5–10	
Bells, Larger			10–30	
Bells, Church Systems				1/2–2
Buzzers	5–6		5–6	
Chimes, Door Single and Multiple-Tone	15–25		15–25	
Chimes, Church Systems				1/2–2
Clocks, Master Impulse	1–2		1–2	
Clocks, Secondary Type	5–1		5–1	
Gongs, Horns, Howlers	10–30		10–30	
Radio, Amateur Transmitting	100–2000			
Radio, Home Receivers	50–500			
Sirens, Small & Heavy-duty			65–250	1–7½
Television receivers	300–1000		300–1000	
Whistles, Air Valve	4–10		4–10	
Whistles, Motor Compressor				1/20-1

LOADS FOR GENERAL ILLUMINATION FROM

In many cases the desirable footcandle intensity is much higher than that obtainable from prevailing practice in general illumination. In such instances, designated by (*), the watts per sq. ft. values specified are intended to provide only for the general illumination needed, and additional supplementary illumination must be provided. The load considerations are thus dependent on specific studies of machine spacing, actual size of areas requiring high entensities, color control, special glare or directional feaures, degree of precision of work, and similar factors

Occupancy	Watts per Sq. Ft.
1. AISLES, STAIRWAYS, PASSAGEWAYS	
10 watts per running foot.	
2. ASSEMBLY	
a. Rough	3
b. Medium	5
c. Fine	5
d. Extra Fine	5
3. AUTOMOBILE MANUFACTURING	
a. Assembly Line	5
b. Frame Assembly	3
c. Body Assembly	5
d. Body Finishing and Inspecting	5
4. BAKERIES	4
5. BOOK BINDING	
a. Folding, Assembling, Pasting	3
b. Cutting, Punching, Stitching, Embossing	4
6. BREWERIES	
a. Brew House	3
b. Boiling, Keg Washing, etc.	3
c. Bottling	4
7. CANDY MAKING	4
8. CANNING AND PRESERVING	4
9. CHEMICAL WORKS	
a. Hand Furnaces, Stationary Driers and Crystalizers	3
b. Mechanical Driers and Crystalizers, Filtrations, Evaporators, Bleaching	3
c. Tanks for Cooking, Extractors, Percolators, Nitrators, Electrolytic Cells	3
10. CLAY PRODUCTS AND CEMENTS	
a. Grinding, Filter Presses, Kiln Rooms	3
b. Moldings, Pressing, Cleaning, Trimming	3
c. Enameling	3
d. Glazing	4
11. CLOTH PRODUCTS	
a. Cutting, Inspecting, Sewing	
(1) Light Goods	5
(2) Dark Goods	5
b. Pressing, Cloth Treating (Oil Cloth, etc.)	
(1) Light Goods	3
(2) Dark Goods	6
12. COAL BREAKING WASHING, SCREENING	3
13. DAIRY PRODUCTS	4
14. ENGRAVING	5
15. FORGE SHOPS	
a. Rough Work	3
b. Welding	3
16. FOUNDRIES	
a. Charging Floor, Tumbling, Cleaning, Pouring, Shaking Out	3
b. Rough Molding and Core Making	3
c. Fine Molding and Core Making	4
17. GARAGES	
a. Storage	3
b. Repair and Washing.....	*3
18. GLASS WORKS	
a. Mixing and Furnace Rooms, Pressing and Lehr Glass Blowing Machines	3
b. Grinding, Cutting Glass to Size, Silvering	5
c. Fine Grinding, Polishing, Beveling, Etching, Inspecting, etc.	5
19. GLOVE MANUFACTURING	
a. Light Goods	
(1) Cutting, Pressing, Knitting, Sorting	5
(2) Stitching, Trimming, Inspecting	5
b. Dark Goods	
(1) Cutting, Pressing, etc.	5
(2) Stitching, Trimming, etc.	5
20. HANGARS—AEROPLANE	
a. Storage—Live	3
b. Repair Department	*5
21. HAT MANUFACTURING	
a. Dyeing, Stiffening, Braiding, Cleaning and Refining	
(1) Light	3
(2) Dark	5
b. Forming, Sizing, Pouncing, Flanging, Finishing and Ironing.	
(1) Light	3
(2) Dark	6
c. Sewing	
(1) Light	5
(2) Dark	5
22. ICE MAKING	
a. Engine and Compressor Room	3
23. INSPECTION	
a. Rough	3
b. Medium	5
c. Fine	5
d. Extra Fine	5
24. JEWELRY AND WATCH MANUFACTURING	5
24. LAUNDRIES AND DRY CLEANING	5
26. LEATHER MANUFACTURING	
a. Vats	2
b. Cleaning, Tanning and Stretching	3
c. Cutting, Fleshing and Stuffing	3
d. Finishing and Scarfing	5
27. LEATHER WORKING	
a. Pressing, Winding and Glazing	
(1) Light	3
(2) Dark	5
b. Grading, Matching, Cutting, Scarfing, Sewing	
(1) Light	5
(2) Dark	*5
28. LOCKER ROOMS	2
29. MACHINE SHOPS	
a. Rough Bench and Machine Work	3
b. Medium Bench and Machine Work, Ordinary Automatic Machines, Rough Grinding, Medium Buffing and Polishing	5
c. Fine Bench and Machine Work, Fine Automatic Machines, Medium Grinding, Fine Buffing and Polishing	*5
d. Extra Fine Bench and Machine Work, Grinding	
(1) Fine Work	*5
30. MEAT PACKING	
a. Slaughtering	3
b. Cleaning, Cutting, Cooking, Grinding, Canning, Packing	5
31. MILLING—GRAIN FOODS	
a. Cleaning, Grinding and Rolling	3
b. Baking or Roasting	5
c. Flour Grading	5
32. OFFICES	
a. Private and General	
(1) No close work	5
(2) Close work	6
b. Drafting rooms	7

OVERHEAD SOURCES IN INDUSTRIAL OCCUPANCIES

which necessitate special study. Where machines or operations require supplementary illumination add at least two watts per square foot for the area involved.

These figures are based upon the use of modern high efficiency light sources such as fluorescent and mercury vapor lamps. To achieve equal illumination intensities with incandescent lamps approximately double the watts per square foot values shown will be required.

In general, for present standards of industrial lighting, five watts per square foot is a practical minimum.

Occupancy	Watts per Sq. Ft.
33. PACKING AND BOXING	3
34. PAINT MANUFACTURING	3
35. PAINT SHOPS	
a. Dipping, Spraying, Firing, Rubbing, Ordinary Hand Painting and Finishing	5
b. Fine Hand Painting and Finishing	*5
c. Extra Fine Hand Painting and Finishing (Automobile Bodies, Piano Cases, etc.)	*5
36. PAPER BOX MANUFACTURING	
a. Light	4
b. Dark	5
c. Storage of Stock	3
37. PAPER BOX MANUFACTURING	
a. Beaters, Grinding, Calendering	3
b. Finishing, Cutting, Trimming	5
38. PLATING	5
39. POLISHING AND BURNISHING	5
40. POWER PLANTS, ENGINE ROOMS, BOILERS	
a. Boilers, Coal and Ash Handling, Storage Battery Rooms	2
b. Auxiliary Equipment, Oil Switches and Transformers	2
c. Switchboards, Engines, Generators, Blowers, Compressors	3
41. PRINTING INDUSTRIES	
a. Matrixing and Casting	3
b. Miscellaneous Machines	5
c. Presses and Electrotyping	5
d. Lithographing	*7
e. Linotype, Monotype, Typesetting, Imposing Stone, Engraving	*7
f. Proof Reading	*7
42. RECEIVING AND SHIPPING	3
43. RUBBER MANUFACTURING AND PRODUCTS	
a. Calendars, Compounding Mills, Fabric Preparation, Stock Cutting, Tubing Machines, Solid Tire Operations, Mechanical Goods Building, Vulcanizing	5
b. Bead Building, Pneumatic Tire Building and Finishing, Inner Tube Operation, Mechanical Goods Trimming, Treading	5
44. SHEET METAL WORKS	
a. Miscellaneous Machines, Ordinary Bench Work	5
b. Punches, Presses, Shears, Stamps, Welders, Spinning, Medium Bench Work	6
c. Tin Plate Inspection	*6
45. SHOE MANUFACTURING	
a. Hand Turning, Miscellaneous Bench and Machine Work	3
b. Inspecting and Sorting Raw Material, Cutting and Stitching	
(1) Light	5
(2) Dark	*5
c. Lasting and Welting	5
46. SOAP MANUFACTURING	
a. Kettle Houses, Cutting, Soap Chip and Powder	3
b. Stamping, Wrapping and Packing, Filling and Packing Soap Powder	5
47. STEEL AND IRON MILLS, BAR, SHEET AND WIRE PRODUCTS	
a. Soaking Pits and Reheating Furnaces	3
b. Charging and Casting Floors	3
c. Muck and Heavy Rolling, Shearing (Rough by Gauge), Pickling and Cleaning	3
d. Plate Inspection, Chipping	*5
e. Automatic Machines, Light and Cold Rolling, Wire Drawing, Shearing (fine by line)	5
48. STONE CRUSHING AND SCREENING	
a. Belt Conveyor Tubes, Main Line Shafting Spaces, Chute Rooms, Inside of Bins	3
b. Primary Breaker Room, Auxiliary Breakers under Bins	3
c. Screens	3
49. STORAGE BATTERY MANUFACTURING	
a. Molding of Grids	5
50. STORE AND STOCK ROOMS	
a. Rough Bulky Material	3
b. Medium or Fine Material requiring care	4
51. STRUCTURAL STEEL FABRICATION	3
52. SUGAR GRADING	5
53. TESTING	
a. Rough	4
b. Fine	5
c. Extra Fine Instruments, Scales, etc.	*5
54. TEXTILE MILLS	
a. Cotton	
(1) Opening and Lapping, Carding, Drawing, Roving, Dyeing	5
(2) Spooling, Spinning, Drawing, Warping, Weaving, Quilling, Inspecting, Knitting, Slashing (over beam end)	5
b. Silk	
(1) Winding, Throwing, Dyeing	5
(2) Quilling, Warping, Weaving, Finishing	
Light Goods	6
Dark Goods	7
c. Woolen	
(1) Carding, Picking, Washing, Combing	5
(2) Twisting, Dyeing	5
(3) Drawing-in, Warping—	
Light Goods	6
Dark Goods	7
(4) Weaving—	
Light Goods	6
Dark Goods	7
(5) Knitting Machines	5
55. TOBACCO PRODUCTS	
a. Drying, Stripping, General	3
b. Grading and Sorting	*5
56. TOILETS AND WASH ROOMS	2
57. UPHOLSTERING	
a. Automobile, Coach, Furniture	5
58. WAREHOUSE	2
59. WOODWORKING	
a. Rough Sawing and Bench Work	5
b. Sizing, Planing, Rough Sanding, Medium Machine and Bench Work, Gluing, Veneering, Cooperage	5
c. Fine Bench and Machine Work, Fine Sanding and Finishing	7

RIGID METAL CONDUIT—WEIGHTS AND DIMENSION

Conduit									Elbows		
Trade size, inches	Length	Nominal weight, pounds per foot	External diameter, inches	Nominal internal diameter, inches	Nominal wall thickness inches	Minimum weight 10 lengths, pounds	Threads per inch	Nominal weight, pounds per 100	Dimensions, inches		
									Radius	Ends	C/L to End
½	9' 11½"	0.852	0.840	0.622	0.109	79	14	83	4	2½	6½
¾	9' 11½"	1.134	1.050	0.824	0.113	105	14	123	4½	2¾	7¼
1	9' 11½"	1.684	1.315	1.049	0.133	153	11½	203	5¾	2⅞	8⅝
1¼	9' 11"	2.281	1.660	1.380	0.140	201	11½	318	7¼	2¾	10
1½	9' 11"	2.731	1.900	1.610	0.145	249	11½	432	8¼	2¾	11
2	9' 11"	3.678	2.375	2.067	0.154	334	11½	705	9½	4⅛	13⅝
2½	9' 10½"	5.819	2.875	2.469	0.203	527	8	1,261	10½	5 3/16	15 11/16
3	9' 10½"	7.616	3.500	3.068	0.216	690	8	1,840	13	4¾	17¾
3½	9' 10"	9.202	4.000	3.548	0.226	831	8	2,530	15	5	20
4	9' 10"	10.889	4.500	4.026	0.237	982	8	3,176	16	5 5/16	21 5/16
4½	9' 10"	12.642	5.000	4.506	0.247	1,150	8	4,110	18	5½	23½
5	9' 9"	14.810	5.563	5.047	0.258	1,344	8	6,170	24	5	29
6	9' 9"	19.185	6.625	6.065	0.280	1,770	8	9,590	30	6½	36½

VOLTAGE DROP TABLE

1. To find the size of wire required for a given voltage drop stated in percentage of the line voltage:

Find the "ampere-feet" by multiplying the current in amperes by the length of one wire in feet (not the total length of wire in the circuit).

Find the line voltage in the upper left corner; follow this horizontal line to the right to the given percent drop, follow this column down to the number of ampere-feet nearest to the actual number calculated. Follow this horizontal line to the left. The required size is the size found on this line.

2. To find the percent voltage drop which will be produced by a given size of wire:

Find the ampere-feet as above.

Starting with the given size of wire follow this horizontal line to the right to the number of ampere-feet nearest to the actual number calculated. Follow this column up to the percent drop on the line corresponding to the line voltage.

Volts	PERCENT DROP										
550	4	2	1.6	1.4	1.2	1.0	0.8	0.6	0.4	.....	.....
440	5	2.5	2	1.75	1.5	1.25	1	0.75	0.5	.....	.....
220	10	5	4	3.5	3	2.5	2	1.5	1	0.75	0.5
110	20	10	8	7	6	5	4	3	2	1.5	1

SIZE OF WIRE	AMPERES — FEET (AMPS × SINGLE DISTANCE IN FEET)										
14	.....	.....	1,670	1,460	1,250	1.050	840	630	420	310	210
12	.....	.....	2,660	2,320	1,990	1,660	1,330	1,000	670	500	330
10	10,600	5,300	4,200	3,700	3,170	2,650	2,120	1,590	1,060	790	530
8	16,800	8,400	6,700	5,900	5,000	4,200	3,400	2,520	1,680	1,260	840
6	26,700	13,400	10,700	9,400	8,000	6,700	5,300	4,000	2,670	2,010	1,340
5	33,700	16,900	13,500	11,800	10,100	8,400	6,700	5,100	3,370	2,530	1,690
4	42,500	21,300	17,000	14,900	12,800	10,600	8,500	6,400	4,300	3,200	2,130
3	53,600	26,800	21,400	18,800	16,100	13,400	10,700	8,000	5,400	4,000	2,680
2	67,600	33,800	27,000	23,700	20,300	16,900	13,500	10,100	6,800	5,100	3,400
1	85,200	42,600	34,100	29,800	25,600	21,300	17,000	12,800	8,500	6,400	4,300
0	107,500	53,800	43,100	37,600	32,300	26,900	21,500	16,100	10,800	8,100	5,400
00	135,500	67,800	54,200	47,400	40,700	33,900	27,100	20,300	13,600	10,200	6,800
000	170,900	85,500	68,400	59,800	51,300	42,700	34,200	25,600	17,100	12,800	8,500
0000	215,500	107,800	86,200	75,400	64,700	53,900	43,100	32,300	21,600	16,200	10,800
250,000 c.m.	254,600	127,300	101,900	89,100	76,400	63,700	50,900	38,200	25,500	19,100	12,700
300,000 c.m.	305,600	152,800	122,200	106,900	91,700	76,400	61,100	45,800	30,600	22,900	15,300
350,000 c.m.	356,500	178,200	142,600	124,800	106,900	89,100	71,300	53,500	35,600	26,700	17,800
400,000 c.m.	407,400	203,700	163,000	142,600	122,200	101,900	81,500	61,100	40,700	30,600	20,400
450,000 c.m.	458,300	229,200	183,300	160,400	137,500	114,600	91,700	68,700	45,800	34,400	22,900
500,000 c.m.	509,300	254,600	203,700	178,200	152,800	127,300	101,900	76,400	50,900	38,200	25,500

Advertisers' Product Index

ELECTRICAL CONSTRUCTION & MAINTENANCE • JULY, 1949

The listings under major product headings are of manufacturers advertising those products in this issue in sufficient detail to be of value to specifiers or users of those products.

It is recommended that manufacturers' advertisements listed under each product heading be referred to in order to get complete information.

Lighting Equipment and Lamps

Motors, Motor-Driven Apparatus, Generators, Parts & Accessories

Motor Control Apparatus

Non-metallic Sheathed Cable

Outdoor Wire, Cable & Accessories

Outlet Boxes, Metal

Panelboards, Switchboards, Switchgear, Instruments & Accessories

Porcelain Knobs, Insulators, Tubes, Cleats, Outlet Boxes

Raceways, Underfloor

Signalling and Sound Systems, Chimes, Bells Specialties

Solderless Lugs, Connectors & Accessories

Surface Metal Raceways and Fittings

Switches, Safety, Meter & Entrance

Time Switches, Lighting Control & Timers

Tools

Transformers

Wire & Cable

Wire & Cable Accessories

Wiring Devices

Miscellaneous

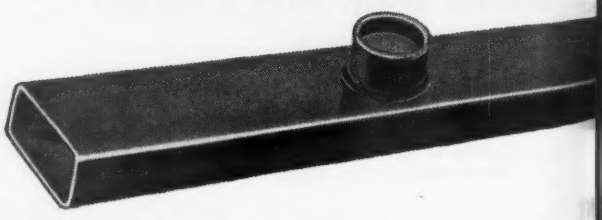
NATIONAL ELECTRIC

CONDUIT SYSTEMS

SHERARDUCT—Full weight, threaded, rigid steel conduit *fortified* against rust and corrosion by the "Sherardizing" process for *life-time* protection.

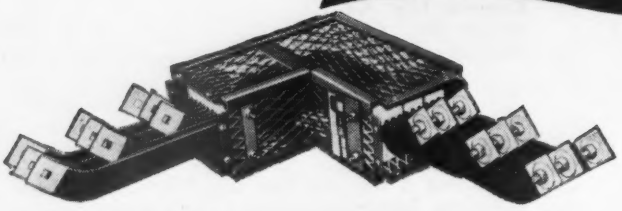
XDUCT JUNIOR—Electrical Metallic Tubing. Electro-galvanized, then further protected inside by *smooth,* lustrous coating of clear, durable enamel.

FLEXSTEEL—Galvanized, flexible-steel conduit. Continuous runs from outlet to outlet reduce installation costs. Provides an economical "pull-in pull-out," grounded system.



NEPCODUCT—The *steel* underfloor duct system that provides convenience outlets at the floor *surface.* For power, lighting, telephone and signal service *in any type of floor construction.*

BUS SYSTEMS

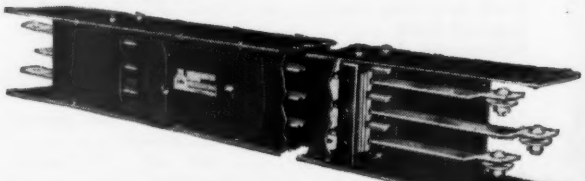


LO-LOSS FEEDER BUS

Highest transmission efficiency due to low voltage drop with all types of load. Recommended for long feeder runs.

STANDARD FEEDER BUS TYPE "A" HOUSING

For normal runs between transformer bank and switchgear equipment. Housings for both indoor and outdoor installations.



I. P. I. "PLUG-IN" BUS

For branch runs from feeder bus. Plug-in openings, staggered on 15-inch centers on two sides, permit insertion of devices *every* 7½ *inches.*

FOR ALL SYSTEMS

NE insulated building wires and cables, connectors, boxes and accessories to meet the requirements of any wiring job.

All Products Listed by Underwriters Laboratories, Inc.

Sold through leading electrical wholesalers

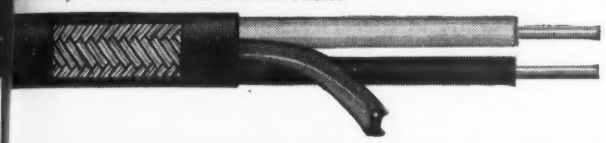
WIRING SYSTEMS

Engineered to Fit the Job

WIRED SYSTEMS

NON-METALLIC SHEATHED CABLES

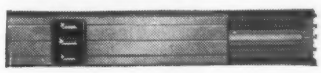
CANVAS BACK LOOMWIRE—A new, small diameter cable for dry locations—normal requirements. Each conductor carries full insulation to terminal screw. Has a saturated, fire-retardant, moisture resistant, cotton-braided sheath.



NE-O-PRENE LOOMWIRE—The *first* Neoprene-sheathed Loomwire to be listed by U/L. For wet locations, stables, farm buildings—where rot, fungus, moisture, ammonia-laden air and drastic weather conditions are destructive to other *approved* wiring.

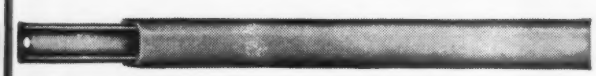
A. B. C. ARMORED BUSHED CABLE—Complete, ready-to-use *grounded* wiring system. Sizes 14 and 12 have low-resistance grounding strip. Furnished with "Dilec Safecote" insulated wires.

PLUG-IN STRIP—"Constant Service" 2-Wire and "Switch-controlled" 3-wire multi-outlet assemblies. Outlets every 18″ or 6″. For residential or commercial use.

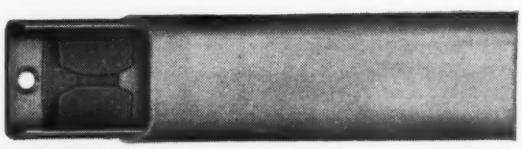


3-Wire PLUG-IN STRIP provides *wall-switch control* for lamps, *plus constant service* for clocks, radios, electric blankets and appliances. Each receptacle—a choice of two services.

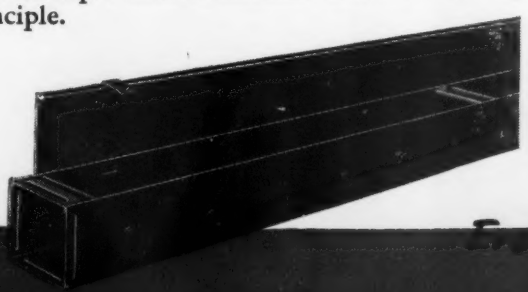
RACEWAY SYSTEMS



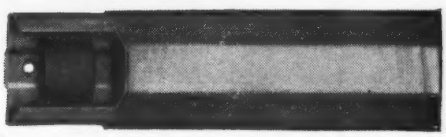
EXTENSIONDUCT—For extending circuits along walls and ceilings. Made with the "lay-in" feature. *No wire fishing necessary.* Attach the base, lay-in the wires, snap on the capping.



METAL MOLDING—For main lighting distribution and multiple branch circuits—also has the "lay-in" principle.



FLORDUCT



For across-the-floor service. Bump-proof, mop-proof, trip-proof—another NE raceway with the "lay-in" principle.

SURFACEDUCT—A 2-piece, all-purpose industrial "lay-in" raceway for every type of service up to 60 amp. Accommodates all manufacturers' approved devices.

4x4 WIREWA—A hinged-lid steel wireway for feeders, branch circuits, control and signal wiring up to 600 volts. Speeds power rewiring. Eliminates exposed wiring hazards.

Everything in wiring points to NE

National Electric
PRODUCTS CORPORATION

1301 CHAMBER OF COMMERCE BLDG., PITTSBURGH 19, PA.

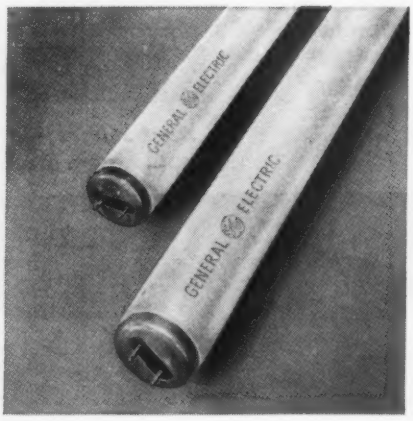
NATIONAL ELECTRIC PRODUCTS — NE — WIRING SYSTEMS AND WIRES AND CABLES

Two ways to shine

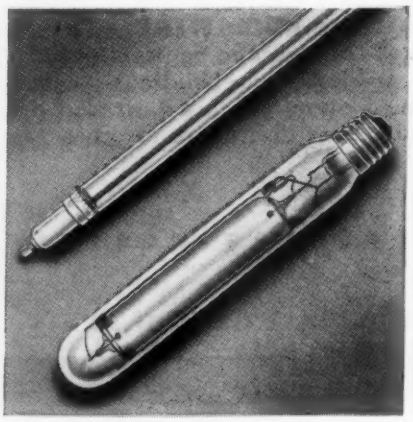
1 MAKE SURE THEY'RE G. E.!

Whatever the job, you can get the right lamps for it from General Electric. The G-E lamps below are only a representative few of the more than 10,000 types and sizes made by General Electric. So don't take chances with customer satisfaction. Always specify G-E lamps. Their quality is assured by more than 480 tests and inspections, and General Electric Lamp research is always at work to make G-E lamps . . . *Stay Brighter Longer!*

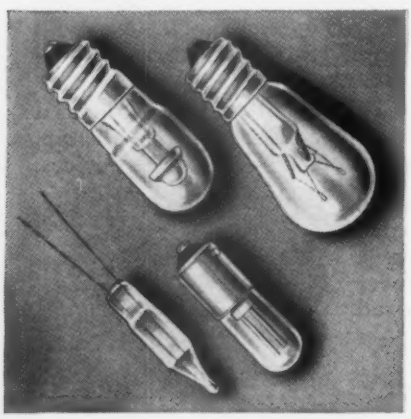
FILAMENT: Clear, inside frosted, daylight —all types and wattages. Silvered bowl for indirect lighting; reflector-spot and reflector-flood, with reflecting surface inside bulb, for special applications.



FLUORESCENT: Steps up working efficiency, increases productivity. In 11 years General Electric Lamp research has increased light output 44%, lengthened life 150% and reduced cost 62.5%.



MERCURY: Lower cost lighting for factories. High light output means fewer fixtures. Rated life is unusually high, depending on the wattage and number of starts.



INDICATOR: Tiny lamps with a big job on instrument panels, warning devices. G-E makes a type for every use—and every lamp is the same dependable high quality.

PROJECTOR: Made of two moulded glass sections, sealed to make a single unit. Has a highly efficient sealed-in reflector and prefocused filament.

INFRARED: Quick heat at low cost for drying, baking, dehydrating, and other uses. General Electric makes all types and sizes. It's easy to get the right G-E lamp.

when you install lamps!

2 MAKE USE OF G-E LIGHTING KNOW-HOW!

There's a General Electric lighting engineer in every General Electric Lamp sales district who is available to help you with difficult lighting problems. Make use of his wide experience. A phone call or letter to your nearest General Electric Lamp office will bring his services to you.

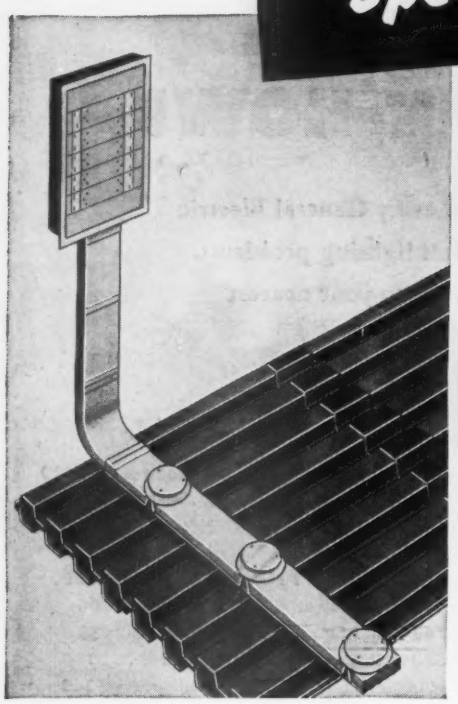
SALES DISTRICTS

(To obtain sales and technical information)

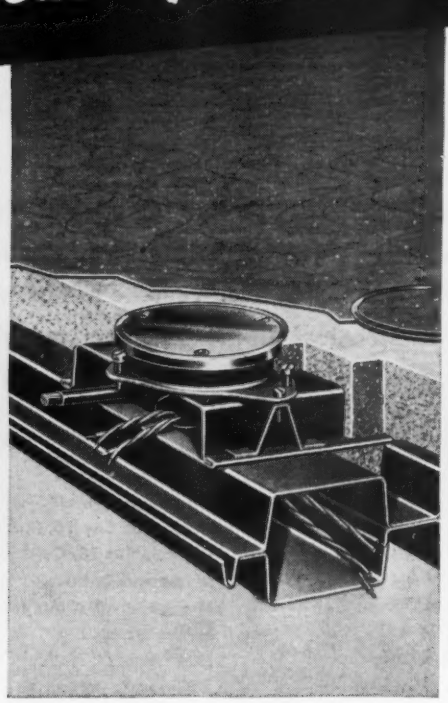
Albany 7, N. Y.	Civil Service Center No. 8, Elk Street	ALbany 3-4447	**Detroit 26, Mich.**	1400 Book Tower	WOodward 3-6910
Atlanta 3, Ga.	187 Spring St., N.W.	WAlnut 9767	**Indianapolis 4, Ind.**	1115 Circle Tower	MArket 2536
Baltimore 1, Md.	101 North Charles Street	MUlberry-7733	**N. Kansas City 16, Mo.**	200 East 16th Avenue	NOrclay 3568
Boston 10, Mass.	50 High St.	HAncock 6-1680	**Los Angeles 13, Calif.**	601 West 5th Street	MIchigan 8851
Buffalo 2, N. Y.	901 Genesee Bldg.	CLeveland 3400	**Milwaukee 3, Wisc.**	5032 Plankinton Building	MArquette 8-8580
Charlotte 2, N. C.	516 Johnston Building	4-8614	**Minneapolis 13, Minn.**	500 Stinson Blvd.	GRanville 7286
Chicago 4, Ill.	231 South LaSalle Street	DEarborn 2-4712	**Newark 2, N. J.**	744 Broad Street	MArket 3-3953
Chicago 4, Ill.	230 So. Clark Street	DEarborn 2-4712	**New York 22, N. Y.**	570 Lexington Avenue	PLaza 5-6300
Cincinnati 2, Ohio	36 E. 4th Street	DUnbar 2460	**Oakland 7, Calif.**	1614 Campbell Street	HIghgate 4-7340
Cleveland 14, Ohio	1320 Williamson Bldg.	CHerry 1010	**Philadelphia 2, Pa.**	1405 Locust Street	KIngsley 5-3336
Dallas 2, Texas	1801 North Lamar Street	CEntral 7711	**Pittsburgh 22, Pa.**	535 Smithfield Street	GRant 3272
Davenport, Iowa	206 East Second Street	2-2646	**Portland 9, Oregon**	1238 N.W. Glisan Street	BEacon 2101
Denver 2, Colo.	1863 Wazee Street	MAin 6141	**Richmond 20, Virginia**	10 West Cary Street	3-2893
			St. Louis 1, Missouri	710 N. Twelfth Blvd.	CHestnut 8920

How General Electric

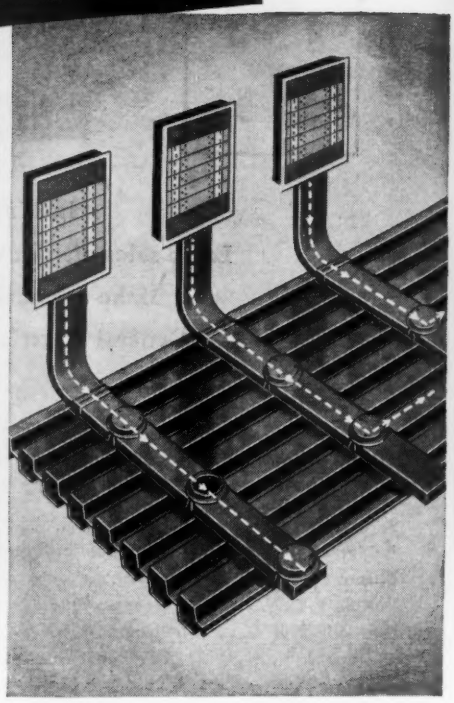
Speeds Up Construction



Q-FLOOR WIRING SIMPLIFIES YOUR JOB The cells of Robertson Q-Floors make a regular, evenly spaced steel raceway system, which your men can wire without special skills. General Electric wiring components for Q-Floor start with rectangular header ducts, extending from panel box across the floor cells. Junction units in the duct permit easy access to all floor cells. Floor taps, outlets, and accessories complete the system. Standard parts throughout save time, make estimating and ordering easy.

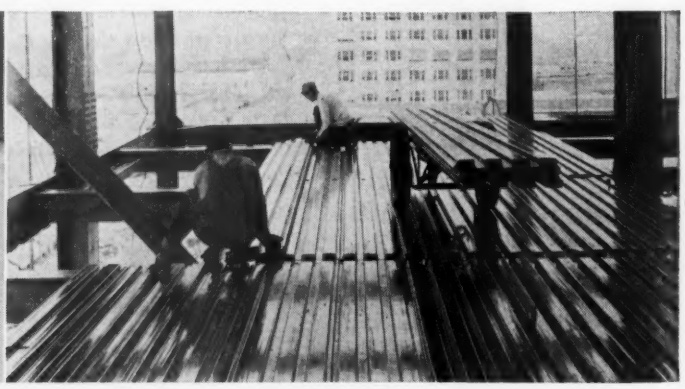


AMPLE WIRING CAPACITY FOR ALL TYPES OF BUILDINGS Any building equipped with General Electric Q-Floor wiring and Robertson Q-Floors gives you a fine opportunity to promote complete electrical usage throughout the building. Ample capacity of each floor cell, and the large number of cells in any floor area, give building operators the opportunity for full and flexible use of electric equipment. It's the system that gives complete, over-all electrical availability.



PUT CIRCUITS IN FAST TO ANY LOCATION Junction units identify proper cells for power, telephone, alarm or other services. Illustration shows header ducts for three-service system. Note how large, easy-to-use, hand holes are located over the particular cells they feed. From hand hole, circuits can be run and outlets installed at practically any spot along the length of the raceway. With cells laid out on six-inch centers, you can spot outlets wherever they're needed.

Q-FLOOR WIRING PRESERVES ORDERLY FLOOR APPEARANCE The job you do with General Electric Q-Floor wiring remains a credit to you as an example of neat, finished work. Hand hole covers, finished with the flooring material, are unobtrusive, yet easy to locate. With the use of more and more electric equipment, maintaining neatness in offices, hospitals, and plants becomes increasingly difficult—but not with Q-Floor wiring.



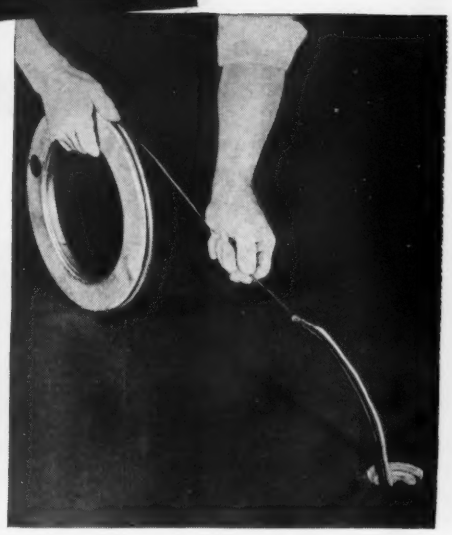
ADDS A SAFETY FACTOR FOR ALL TRADES Because Q-Floor is a complete floor surface, it makes a working platform for all trades. Equipment can be located directly on the floor. Men can work with maximum safety. Material breakage and loss may be reduced. Contractors like working with Robertson Q-Floor and G-E Q-Floor Wiring, because they're a workable, efficient construction combination.

Q-Floor Wiring...

Makes Maintenance Easy

NO INTERRUPTION OF BUILDING ACTIVITIES When new outlets are called for in existing buildings, there's no need for occupants to stop work, no need for extensive furniture moving. The electrician merely opens a small hole in the floor and drills through the Q-Floor cell. With this simple operation, the raceway is open and ready for wires to be pulled through. At junction of header duct and floor cell, the cover is easily removed.

NO NEED TO RIP UP FLOORS Adding circuits or rewiring involves no groping. Conductors from panel are easily pulled through header and into raceways where outlets are to be installed. Existing circuits are easily separated for identification. An adjustable floor tap, with extension, makes outlet installation a matter of only a few minutes. In construction and in maintenance, you'll like the workability of General Electric Q-Floor wiring.



CHANGE CIRCUIT LAYOUTS FAST Any raceway in the Q-Floor wiring system can be easily located at any time. This means you can locate all circuits fast—change circuits quickly to meet changing requirements at any time during the life of the building. This is a great advantage in beating the problem of obsolescence. To you it means a solution to the many problems normally encountered in layout changes and changes in circuit requirements.

WHY NOT SUGGEST Robertson Q-Floors with General Electric Q-Floor Wiring the next time the question of wiring adequacy comes up? This efficient combination is practical for all types of buildings—retail stores, hospitals, office buildings, and factories—for new structures or for additions to existing structures. It's the modern, efficient method of construction—the flexible, practical method of keeping buildings electrically young.

FOR FIRST-HAND INFORMATION, get in touch with your General Electric Construction Materials distributor or H. H. Robertson Company district office. Experts on underfloor distribution methods will gladly give you the whole story and show samples of Q-Floor construction.

IF YOU'D LIKE A HANDY REFERENCE BOOK that answers many questions on General Electric Q-Floor wiring, write on your letterhead for a free copy of the *Q-Floor Wiring Data Manual* to Section C10-718, General Electric Company, Bridgeport 2, Connecticut.

GENERAL ELECTRIC

2 great magnet wires from a single source

TO FILL EVERY WINDING NEED

To provide a full range of sizes, shapes, and insulations . . . for a wide variety of applications . . . General Electric offers two great names in magnet wires—Formex, for temperatures to 105 C; and Deltabeston, for temperatures to 125 C.

Formex is a tough, workable magnet wire—insulated with synthetic resin — that is famous for speedy winding and extremely long operating life. Chemical-resistant, heat-shock-resistant, abrasion-resistant, small-diameter Formex magnet wires are available in all common sizes and shapes.

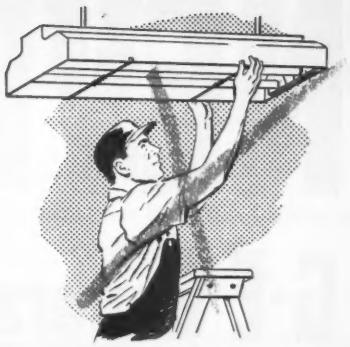
Deltabeston magnet wires, insulated with glass or with asbestos, are high-heat magnet wires that permit operation at temperatures higher than those allowable for ordinary cotton- or enamel-insulated wires. Deltabeston magnet wires are available in all the usual sizes and shapes.

Contact your G-E construction materials representative or distributor for detailed information about this complete magnet wire line. For the latest booklet on General Electric magnet wires, write to Section W40-718, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

GENERAL ELECTRIC

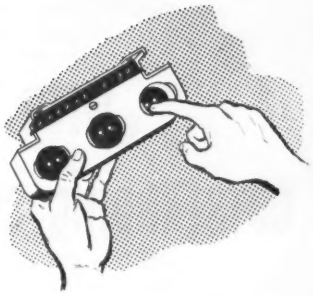
The slow process of replacing lamps with two hands is out when fixtures are equipped with General Electric Turret lampholders.

There are no clips or safety gadgets to fuss with when your fixtures are equipped with Turrets. Snug fit and uniform spring tension hold lamp securely in place—automatically keep firm contact.



Now, lamp changing is a fast, easy, one-hand operation. And there's no need to worry about breaking lampholders, because Turrets are sturdy, can take rough handling.

Spring action is the secret of the Turret's simplicity of operation. To insert a lamp just push in contact plate and turn lamp slightly to seat pins. Swing free end of lamp up and lamp slides firmly into place.



Cut Lamp Maintenance Time

Specify fixtures

WITH G-E TURRET® LAMPHOLDERS

Check these features of G-E Turret lampholders

—Check the fixture you buy for G-E Turret lampholders

✓ **Safety** . . . The hazard of falling lamps is virtually eliminated.

✓ **Convenience** . . . Lamps can be installed from either end of fixture with one fast, easy motion.

✓ **Economy** . . . Turrets take hard, rough handling without being damaged . . . costly replacement problems are eliminated.

✓ **Service** . . . All Turret lampholder working parts are made to give long service —the sturdy metal construction is designed to stand hard usage.

✓ **Availability** . . . Turrets are available in three sizes to simplify fixture design and to permit a wide selection of lamp arrangements.

✓ **Efficiency** . . . When fixtures are equipped with Turrets, lamps are not staggered but are mounted in a straight line, thus giving maximum efficient, shadowless lighting.

If you're interested in fluorescent lighting why not write for more information on G-E Turret lampholders and the features they give to fixtures equipped with them? Address Section Q54-718, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

Now for Slimline lamps

Now, General Electric makes Twin Turret lampholders for two 96-inch Type T-12 Slimline lamps. These new Slimline Turrets have all the big features of the standard line of Turrets.

GENERAL ELECTRIC

NEVER BEFORE!

A G-E General-Purpose* Insulating Varnish

WITH THESE OUTSTANDING CHARACTERISTICS

G.E.'s new 9574

☑ EXCELLENT BONDING STRENGTH

General-purpose 9574 has excellent bonding properties. It is ideal for all types of motor windings (except extra high-speed armatures), and has outstanding electrical characteristics.

☑ EASIER TO WORK

G-E 9574 is a phenolic drying-oil varnish. It's particularly easy to use and handle. It has an unusually high flash point (100 F), and its viscosity (250 C. P. average at 45 F) makes it usable at barrel gravity.

☑ NO SPECIAL THINNERS REQUIRED

G-E 9574 can be thinned with ordinary petroleum spirits up to 20%.

☑ CURES AT LOW TEMPERATURES

This clear-baking varnish cures at low temperatures. A baking cycle as low as 212 F is successful in conventional baking equipment.

☑ PENETRATES DEEPEST COILS

G-E 9574 easily penetrates the deepest coils, forms an even film. Aging properties are excellent.

**G-E 9574 gives excellent results on all types of coils except extra high-speed armatures.*

MAKE YOUR MOTOR REPAIRS EASIER, MORE EFFICIENT BY USING G-E 9574!

Get more information on this remarkable general-purpose insulating varnish. New bulletin gives you full details. Just write to your local G-E Distributor or Chemical Department, General Electric Company, Pittsfield, Mass.

You Can Put Your Confidence in

GENERAL ELECTRIC

CD49-M2

You know you're right with "G-E White"

Clean-cut threads and uniformly high quality are only two of several features that make General Electric white rigid conduit the first choice of electrical contractors and maintenance men everywhere. Other considerations are its *hot-dipped* zinc coating —fused into high-grade steel—and its tough, smooth-as-glass Glyptal* lacquer finish, inside and out.

Always, when you think of rigid conduit . . . think of "G-E White." For further information, see your nearest General Electric Construction Materials distributor, or write to Section C15-670, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

*Trade-mark Reg. U. S. Pat. Off.

RACEWAYS ROUNDUP
with your
GENERAL ELECTRIC
Construction Materials Distributor

Still the favorite for wiring protection against chemical corrosion is General Electric black rigid conduit. "G-E Black" is made from the same high-grade steel—and is manufactured with the same precision—as "G-E White." The tough, glassy-smooth, baked-on enamel makes wire pulling easy, and is an excellent paint base.

General Electric switch and outlet boxes are made in a variety of sizes, shapes, and depths for every purpose. The entire line of G-E boxes is available with galvanized finish. All cable and conduit boxes have improved knockouts, are easy to install, and have the approval of Underwriters' Laboratories, Inc.

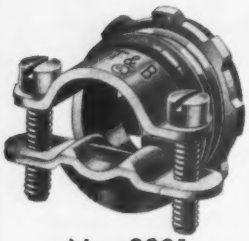
General Electric fittings and accessories for the complete line of G-E conduit products are available. Carefully designed connectors, nipples, couplings, and other fittings make installation of G-E raceways simple and fast. All types of connectors for armored and nonmetallic cables are included in the G-E line. When installing any type of electric wiring, make sure you use General Electric fittings.

On your next order, why not try the time-saving, "one-stop, one package" service that your General Electric distributor can supply? Because he carries the complete General Electric line, you can order every item you need from him. No need to run around getting part of your requirements in one place and part in another. It's the kind of service busy contractors need to help stretch scarce working hours.

GENERAL ELECTRIC

Conduit Products

No. 300



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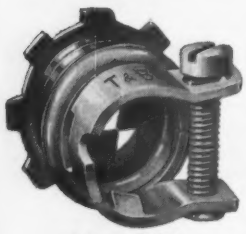

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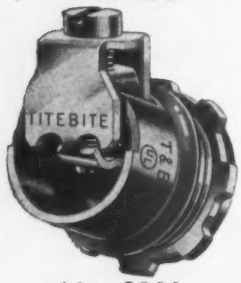

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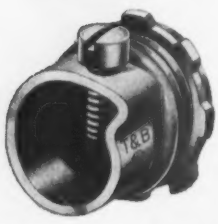
No. 2020



No. 240

OTHER CONNECTORS AVAILABLE

T&B ENGINEERED

AVAILABLE NOW!

The Entire NEW 1949 Line of T & B Connectors Unsurpassed in Quality Unexcelled in Performance

Not just connectors, but *superlatively engineered* connectors backed up by the name and experience of one of the oldest and best-known manufacturers in the industry . . . an *entire line* completely redesigned, completely modernized since the war . . . a line in *full production now* on T&B's new batteries of high-speed, automatic machinery and *available for immediate delivery* from stock today! Don't hang your reputation on unknown, untested products—install the best, profit from top performance—buy the new T&B connectors at your electrical wholesaler now!

BETTER PRODUCTS
BETTER SERVICE
LOWER COSTS

THROUGH AND BECAUSE OF YOUR ELECTRICAL WHOLESALER

THE THOMAS & BETTS CO.
INCORPORATED

ELIZABETH 1 **NEW JERSEY**

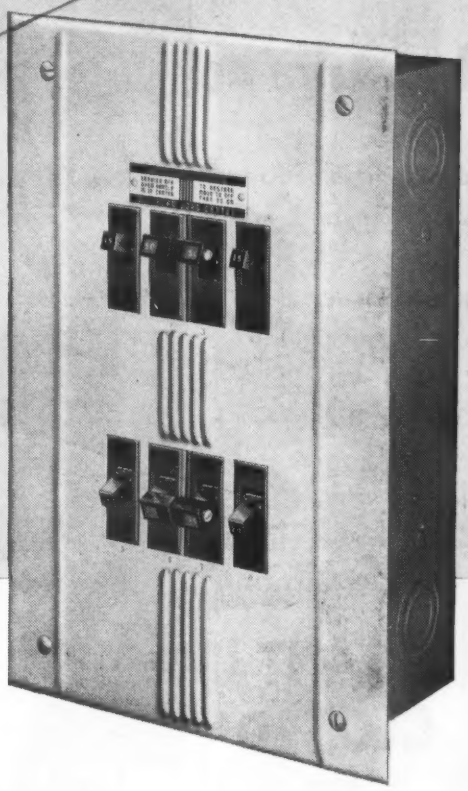
ADEQUATE WIRING THE KEY TO ELECTRICAL LIVING

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

Quicklags CLICK with everyone!

If the lights go out... a flip of the switch restores service. As convenient as that! No fuses to replace... and so simple and safe that even a child can operate it.



and here's why they'll CLICK with you

Everyone is enthusiastic about the new Quicklag Loadcenter. That's because Quicklags add a modern touch of quality to any home . . . combine years of dependable wiring protection with real convenience . . . and make it easy for you to sell a more adequate wiring job to prospects and homeowners.

You stock a few basic devices, breakers of various ratings, flush and surface-type covers. That is all. With this basic equipment you can tailor the Loadcenter to fit the circuit protective requirements of any home . . . and you can do it on the job. The breaker pan lifts completely out to provide plenty of wiring room and the breakers simply snap into place. What's more, the spring-backed breaker pan automatically adjusts the breaker assembly up to the cover.

See the new Quicklag Loadcenter at your nearest Westinghouse supply house, or write for Booklet B-3881. Address Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-60666-A

Westinghouse

QUICKLAG LOADCENTERS

IT'S EASIER!

if you plan your power distribution system first

Eliminate plant shutdowns due to power system changes. Realize new plant economies!

Plan your Power System *before* you set up your new production areas. Choose the "one best" system that answers *all* of your power requirements.

It may not be the system with the lowest initial investment. *But,* it will prove to be the lowest in cost *over a period of years.*

Remember—production records are set *only* if your power system can handle the load. The problem of selecting such a system varies. BUT . . . *Westinghouse can help you find YOUR answers!*

We have worked in close co-operation with *all types* of industries. This wide application experience has given us an intimate knowledge of every phase of power distribution and applications.

CONSULT WESTINGHOUSE . . . and get real help in adapting distribution systems to *your* specific problems. J-94789

If you're expanding or building a new production area . . . get this invaluable information NOW!

1. A New 34-Page Booklet: "Industrial Plant Distribution System", B-4045. Fact-filled pages and colorful diagrams present the basic systems most widely used in industry today. Find how to choose the *best system* for *your* plant.

2. System Selector: A wealth of information condensed to a pocket-size selector! In a matter of minutes you can make preliminary estimates on the system that answers *your* requirements. Ask for SA-6116.

3. Color Movie: Get all the facts visually! This 16mm full-color movie is a 20-minute dramatization that will point the way to new economies in plant power distribution. Ask one of our representatives for a free showing of "The Right Power Distribution System". No obligation, of course.

Call your nearest Westinghouse office, or write Westinghouse Electric Corporation P. O. Box 868, Pittsburgh 30, Pennsylvania.

Westinghouse

SYSTEM PLANNING SERVICE

How will

Dry-Type Power Centers

provide BETTER answers to your power distribution needs?

FIRST CONSIDER ALL THESE ADVANTAGES

- Fire and explosion-proof
- No exposed live parts
- Positive interlocking of circuit breakers and switches
- Separate breaker compartments

- Costly vaults eliminated
- Location near center of load
  - Shorter secondary cables—less copper
  - Better voltage regulation
  - Lower line losses
- Light weight

- No testing or reconditioning of liquids
- No maintenance of gaskets, valves and level gauges
- All parts readily accessible
- Drawout circuit breakers quickly inspected or replaced

- Shipped complete—installed as a unit
- Light weight

- "Unitized" design saves valuable floor space

- Undivided responsibility for manufacture and correct functioning of all equipment
- Factory-assembled and tested—as a unit

- Enclosures of modern matched design

WESTINGHOUSE

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Now, Do You Have All the Answers?

. . . no, not quite, for it is almost imperative that you select the *best* power distribution *system* possible.

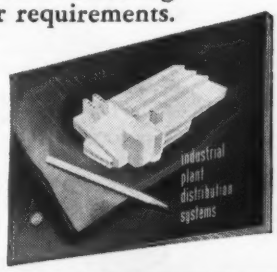
What is the Best system?

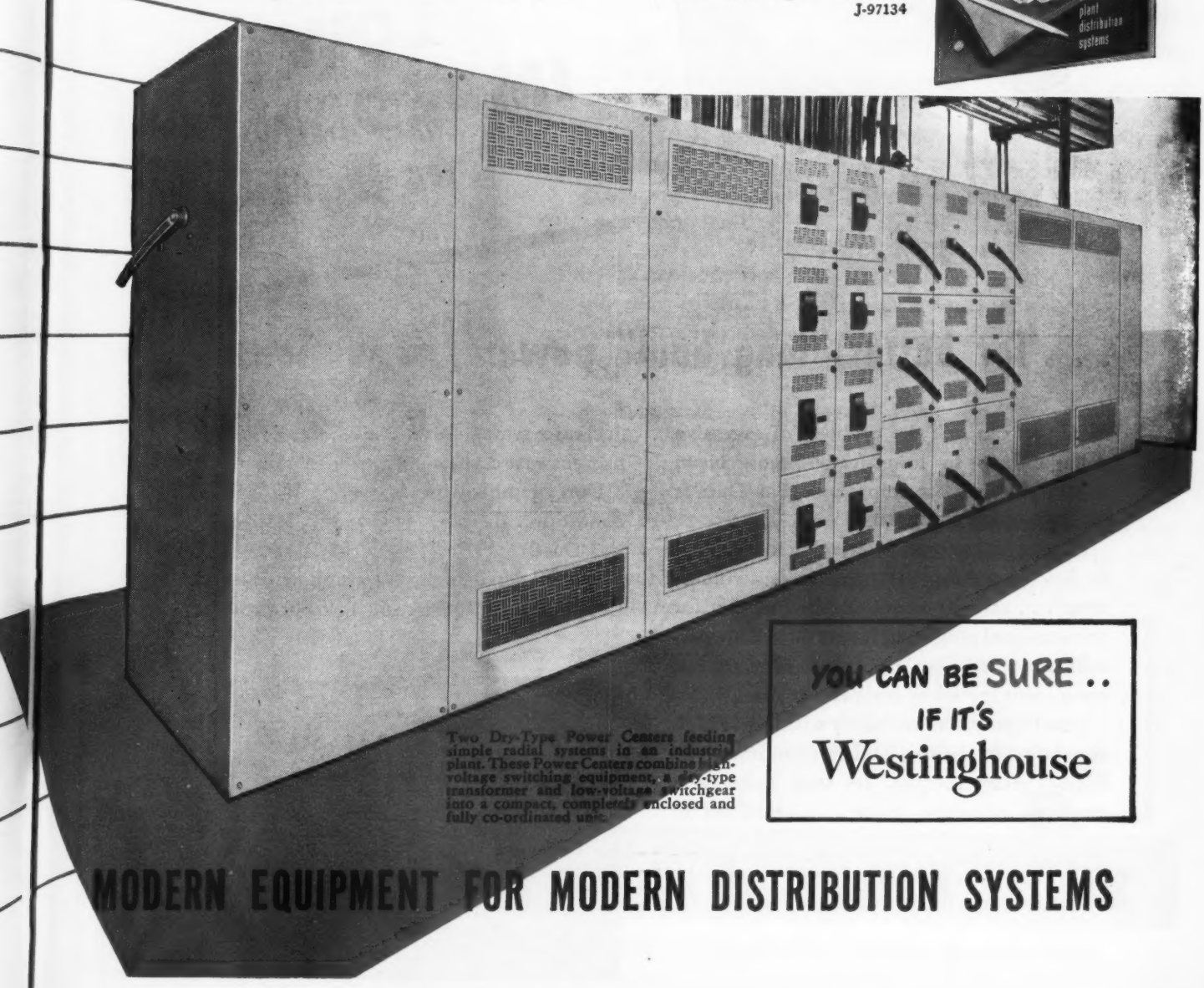
. . . it is the system which gives the greatest value per dollar of investment *and* economically and safely supplies adequate electric service to both the present and future plant loads.

Close Westinghouse co-operation and years of practical experience with all types of industries have led to many outstanding achievements in the development of new distribution systems, methods and equipment. Westinghouse offers such co-operation to all industries in searching out better answers to all phases of distribution and application of power.

Write for the new booklet *"Industrial Plant Distribution Systems"*. Fact-filled pages and colorful diagrams will help you in selecting a system that best meets your requirements. Call your Westinghouse office. Ask for B-4045—or write Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

J-97134





Two Dry-Type Power Centers feeding simple radial systems in an industrial plant. These Power Centers combine high-voltage switching equipment, a dry-type transformer and low-voltage switchgear into a compact, completely enclosed and fully co-ordinated unit.

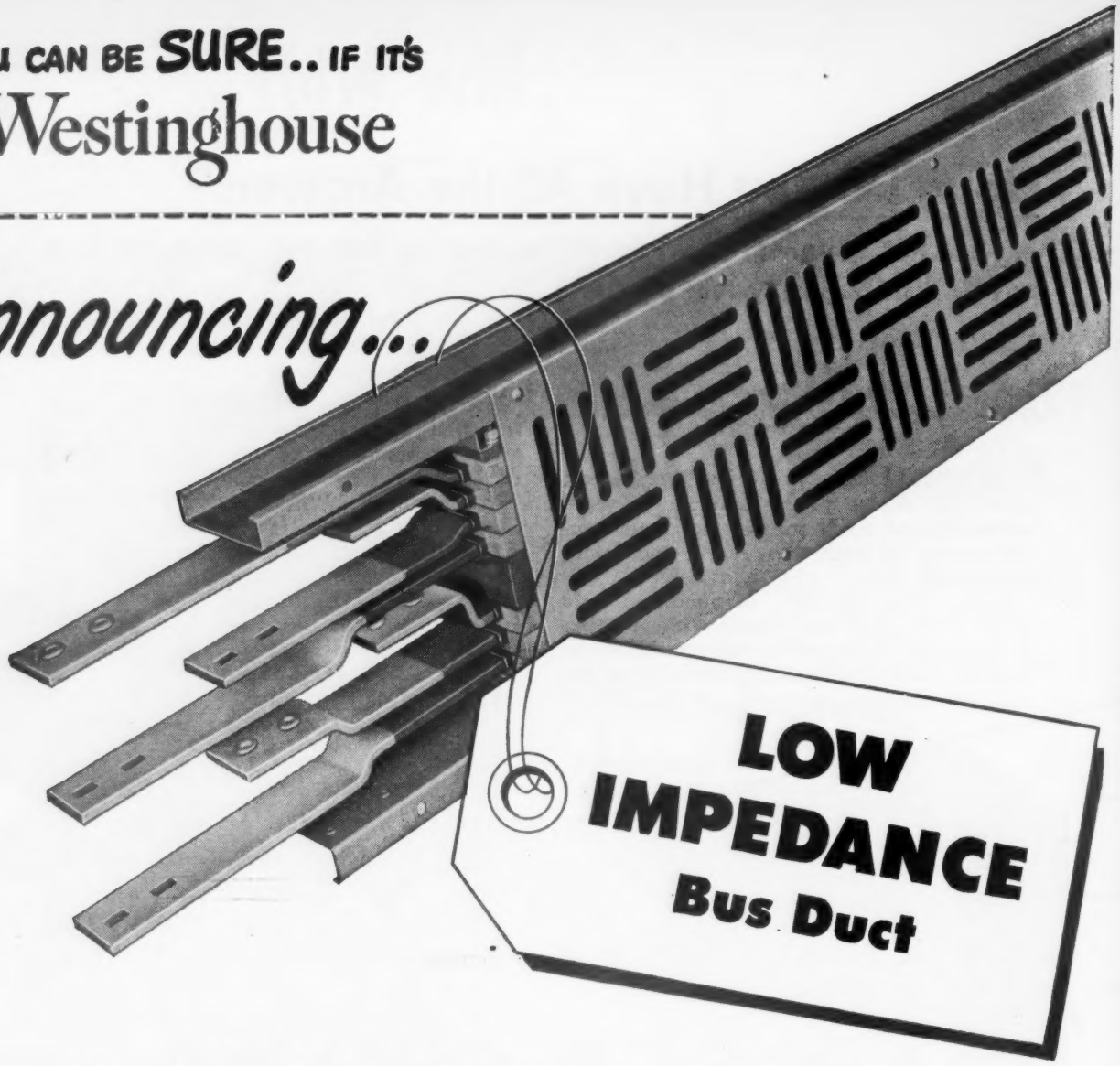
YOU CAN BE SURE . .
IF IT'S
Westinghouse

MODERN EQUIPMENT FOR MODERN DISTRIBUTION SYSTEMS

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

Announcing...



. . . for better "long haul" power distribution

Now you can lick the problem of excessive voltage drop in long feeder runs. New, Westinghouse Low Impedance Bus Duct is the equipment you need.

Close spacing and interlacing of busbars in low impedance duct assure *low* voltage drop . . . actually about one-half of that for conventional plug-in or feeder duct. This permits more efficient operation of electrical equipment served by long feeder runs.

Low impedance duct safely withstands high short-circuit stresses and is economical on high-capacity circuits. Its steel housing is *small* to conserve space . . . *ventilated* to decrease temperature rise . . . *Bonderized* to prevent rust and corrosion.

Don't gamble with a crippling low-voltage condition. Be *sure* with Low Impedance Bus Duct!

For full details write Westinghouse Electric Corporation, P.O.Box 868, Pittsburgh 30, Pa.

J-30002

Westinghouse Bus Duct

Installing electrical conduit?

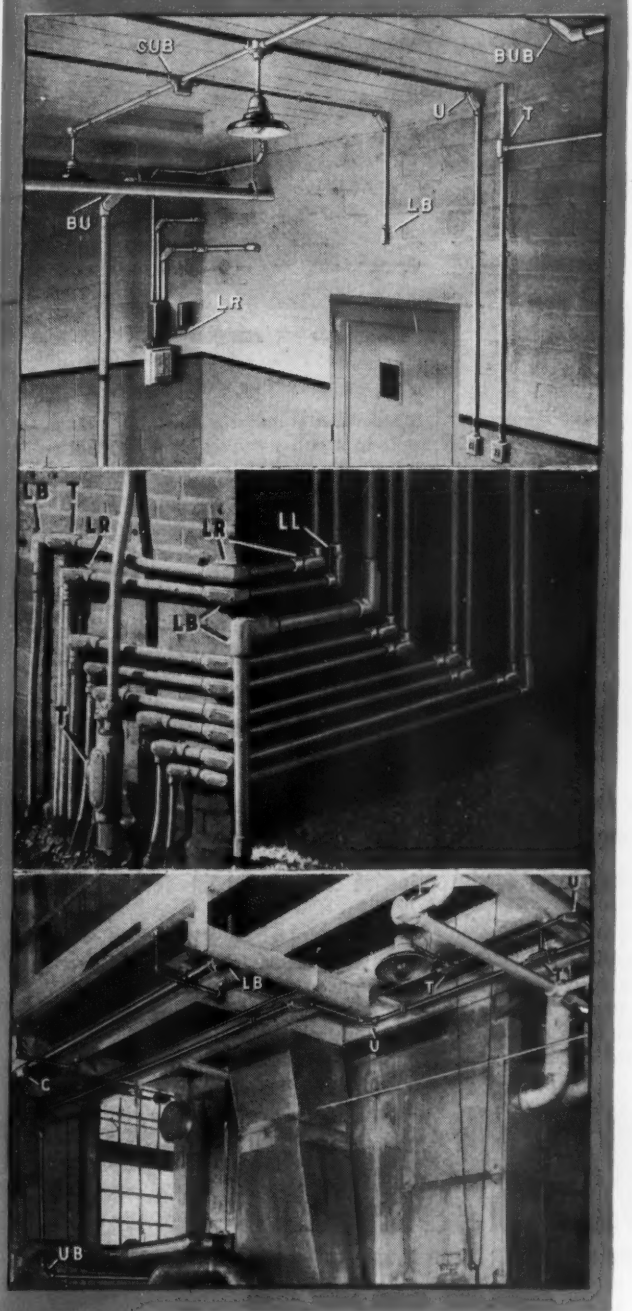
SPECIFY

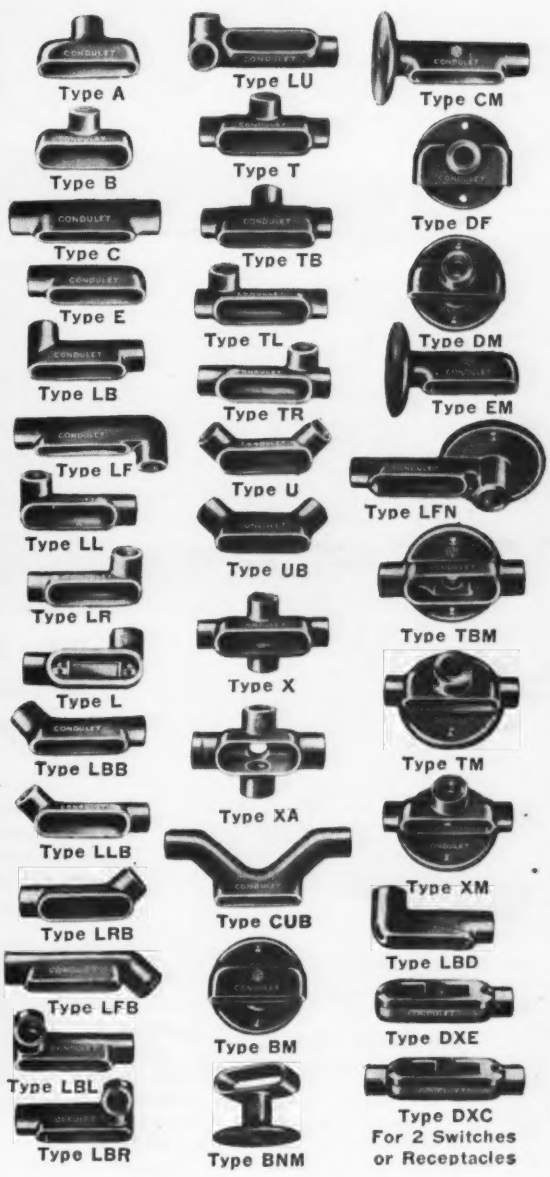
Obround CONDULETS*

because they are so handy and there are

49 different types

A wide variety of interchangeable covers and wiring devices with Crouse-Hinds' exclusive Wedgenut Fastener; sizes to fit ½ to 6-inch electrical conduit.





A Nationwide Distribution Through Electrical Wholesalers

*CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

The complete Obround Series, together with 15,000 other items for the electrician, is listed in Crouse-Hinds Condulet Catalog.

CROUSE-HINDS COMPANY

Syracuse 1, N. Y.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City Los Angeles — Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle St. Louis — Washington. *Resident Representatives:* Albany — Atlanta — Baltimore — Charlotte — New Orleans — Richmond, Va. CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

What makes a good tape GOOD?

To manufacture good serviceable tape certain standards must be met. A short cut on any one point would result in a sub-standard product. Accurate production strictly adheres to the 5 quality points below—at all times.

1 Fine strong straight woven cotton fabric base.

2 High quality, clean rubbers scientifically blended to form a stable, tacky, adhesive impregnating compound.

3 Impregnation of the sheeting with the compound by steel calendar rolls operating at different peripheral (friction) speeds. That's where friction tape gets its name. Tape made by less costly methods isn't genuine friction tape.

4 Slitting to desired width on specially designed machines to assure clean, non-raveling edges.

5 Proper packaging in handy protective cartons and tins to keep tape clean.

That's the way ACCURATE Friction Tape is made. It's the reason every foot is of consistently high quality. Friction or rubber, use ACCURATE Tapes for best results because all are made to highest standards for your protection. There is an ACCURATE distributor near you. Ask for his name today. Just write Accurate Mfg. Company, Garfield, New Jersey.

MEMO FOR CONTRACTORS!

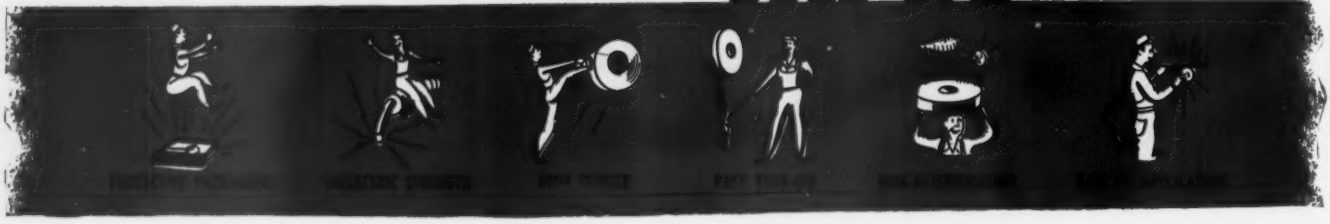
THE HANDY 10-ROLL PROTECTIVE CONTAINER

Keeps tape clean and fresh on the job. It's a good idea to have a few always on hand in your field stockroom, ready for use when you need it.

ACCURATE

25 YEARS MAKING TAPES EXCLUSIVELY

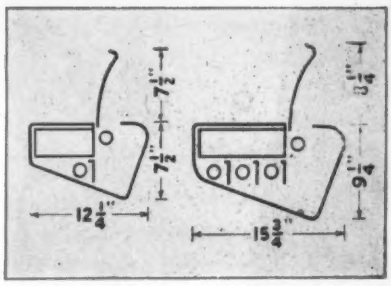
TAPES



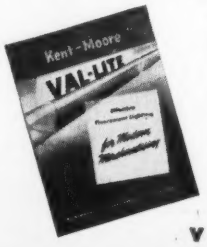
for modern merchandising

NEW KENT-MOORE VAL-LITES GIVE YOU BRILLIANT ILLUMINATION, DISTINCTIVE DISPLAYS, EFFECTIVE ADVERTISING!

Ok, contractors, get ready for new business. Volume business, too, that'll come your way as soon as you offer Kent-Moore VAL-LITES. For VAL-LITES are a new type fixture beamed three ways at your big retail store lighting market. 1—They provide bright, efficient fluorescent lighting in single or multiple unit application. 2—They dramatize merchandise, create distinctive wall and counter displays. 3—And attractive VAL-LITE letters . . . easy-to-read, easy-to-change . . . stand out boldly against a glow of back-lighting for effective "point-of-purchase" advertising or department identification.



VAL-LITES Available in Two Popular Sizes!
Model J1817: four 40-watt fluorescent lamps.
Model J3949: two 40-watt fluorescent lamps.

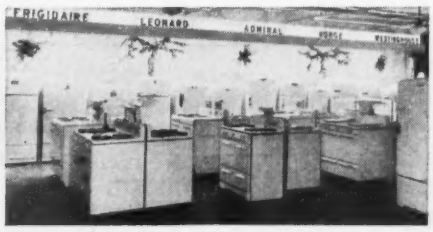


Smartly styled, sturdily built, union made. Approved by Underwriters'. Sold through leading electrical wholesalers. Write today for complete details and ask for the new VAL-LITE Catalog.

KENT-MOORE ORGANIZATION, INC.
GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN

VAL-LITES BUILD SALES FOR YOU AND YOUR CUSTOMERS

Kent-Moore VAL-LITES are a "natural" for super markets. Merchandise sparkles, and customers can find it fast.



Brand names stand out against VAL-LITE backlighting while appliances below make a "buy-appealing" display.

This automobile dealer increased mechanic efficiency by lighting and labeling his service department bays.

INSULATED WIRE AND CABLE OF

ALCOA EC ALUMINUM

ON THE JOB TODAY

LIGHT WEIGHT • LOW COST

CHARTS, DIAGRAMS, ILLUSTRATIONS ANSWER QUESTIONS LIKE THESE:

Q What conduit sizes are required for wire and cable with Aluminum conductors?

Q Has Aluminum been proved in actual installations? For how long?

Q How does Aluminum handle?

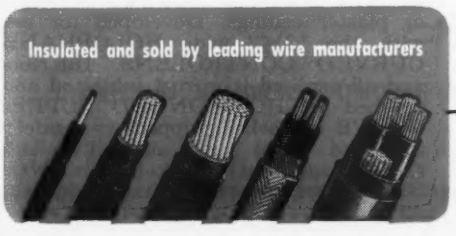
Q What kind of terminations can I make with Aluminum?

These and many other basic questions about this lightweight, low-cost wire and cable, made with Alcoa E. C.* Aluminum, are answered in Alcoa's new booklet, "Alcoa E. C. Aluminum for Electric Wire and Cable". It's yours for the asking. Just write us, on your company letterhead, for your free copy. Be sure to pass this booklet on to others in your organization.

Alcoa makes light, strong, conductive E. C. Aluminum which leading wire manufacturers draw, strand and insulate, and sell under their own trademarks. It's available in required types of insulation to help you make installations faster and at lower cost.

ALUMINUM COMPANY OF AMERICA, 2197G Gulf Building, Pittsburgh 19, Pennsylvania.

*E. C.: *Electrical Conductor* Aluminum



ALCOA EC ALUMINUM

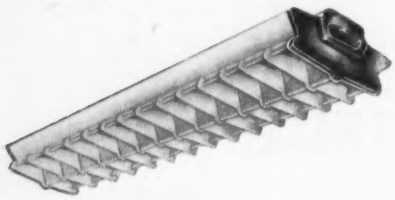
FOR ELECTRIC WIRE AND CABLE

DAY-BRITE

A COMPLETE LINE OF QUALITY FLUORESCENT FIXTURES

COMMERCIAL FIXTURES

PAT. No. D-153001



the LENOX-2* for two 40-watt lamps —direct or suspension mounting—single unit or continuous installations

the LENOX-4* for four 40-watt lamps —direct or suspension mounting—single unit or continuous installations

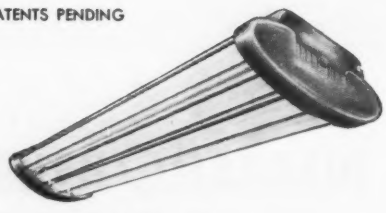
Shielded type companion fixtures designed to combine high efficiency with low brightness ratios. All steel construction throughout. Enclosures snap on and off instantly, supported by service chains. Interlocked louvers make enclosures one rigid unit. Engineered for easy, economical installation and maintenance. Enclosure sides finished in HOT-BONDED SUPER-WHITE enamel, with baked lustre aluminum ends. Wired with certified ballasts (ETL approved), sockets and NO-BLINK type starters. The Lenox-2: 6 1/16" deep, 11 7/8" wide, 48 1/2" in length. The Lenox-4: 6 3/16" deep, 16 3/16" wide, 48 1/2" in length.

PAT. No. D-140387

the TOPNOTCH* for two 40-watt lamps—direct or suspension mounting—single or continuous installations

Open type unit . . . efficient . . . easy to install and maintain. Chassis is of die-formed steel construction, finished in HOT-BONDED SUPER-WHITE enamel. Die-formed steel end plates are finished in baked lustre aluminum enamel. Fixtures wired with certified ballast (ETL approved), sockets, and NO-BLINK type starters. 4 3/4" deep, 9 1/4" wide, 48 1/2" in length.

PATENTS PENDING



the FAIRWAY* for four 40-watt lamps —direct or suspension mounting—single or continuous installations

Open type unit with many practical applications. The sturdy chassis is steel . . . of die-formed and welded construction. Efficient and simple to install and maintain. Chassis finished in HOT-BONDED SUPER-WHITE enamel, decorative die-formed steel end plates are finished in baked lustre aluminum enamel. Fixtures wired with certified ETL approved ballast, sockets, and NO-BLINK type starters. 5 1/16" deep, 12 1/2" wide, 48 1/2" in length.

PAT. Nos. D-138990, D-143641 and 2411952

the VIZ-AID* for two 40-watt or two 85-watt lamps—direct or suspension mounting—single unit or continuous installations

Shielded type unit using same basic chassis for single or continuous installations. Special "V" shaped specular Alzak center louver provides added overall efficiency and punch. Enclosure finished in baked lustre aluminum enamel. Lateral louvers and interior finished in HOT-BONDED SUPER-WHITE enamel. Side panels are of ribbed, diffuse glass. Snap-on enclosures easily installed and removed. Lamps may be removed through top without disturbing enclosure. Fixtures wired with certified ballast (ETL approved), sockets, and NO-BLINK type starters. 40-watt Viz-Aid: 6 1/4" deep, 13" wide, 48 1/2" in length. 85-watt Viz-Aid: 8" deep, 16" wide, 60 1/2" in length.

the VIZ-AID* ALL-WHITE for two 40-watt lamps—direct or suspension mounting—single unit or continuous installations

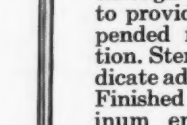
Identical in engineering and construction to the 40-watt Viz-Aid. Entire fixture finished in HOT-BONDED SUPER-WHITE enamel.

the "A-J"* ADJUSTABLE HANGER

Allows 1 3/16" vertical adjustment through hand operated fittings to provide easy leveling of suspended fixtures after installation. Stems are calibrated to indicate adjustment up and down. Finished in baked lustre aluminum enamel, supplied with swivel fittings and all parts necessary to hang suspended type fixtures. In two lengths, 8 1/2" and 28 1/2".

RECESSED TROFFERS

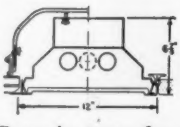
BOXCO* LOUVERED TROFFERS



for two or three 40-watt lamps—single unit or continuous installations

Snap-in type for use with Tee-Bar construction and flange type for accoustical and plaster ceilings. Entire hinged louver can be easily installed or removed. All exposed parts rust inhibited and finished in HOT-BONDED SUPER-WHITE enamel. Equipped with safety fuse and wired with certified ballast (ETL approved), sockets, and NO-BLINK type starters. Fixture length: 48".

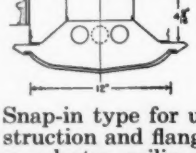
HOLOPHANE CONTROLENS* TROFFERS



for two or three 40-watt lamps—single unit or continuous installations

Snap-in type for use with Tee-Bar construction and flange type for accoustical and plaster ceilings. CONTROLENS can be easily removed for servicing without use of tools. Interiors and all exposed trim rust inhibited and finished in HOT-BONDED SUPER-WHITE enamel. Equipped with safety fuse and wired with certified ballast (ETL approved), sockets, and NO-BLINK type starters. Fixture length: 48".

HOLOPHANE CURVED CONTROLENS* TROFFERS



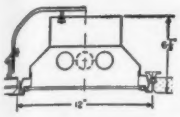
for two or three 40-watt lamps—single unit or continuous installations

Snap-in type for use with Tee-Bar construction and flange type for accoustical or plaster ceilings. Developed for use with the 13 1/2" wide HOLOPHANE CURVED CONTROLENS. Interiors and all exposed trim rust inhibited and finished in HOT-BONDED SUPER-WHITE enamel. Equipped with safety fuse and wired with certified ballast (ETL approved), sockets, and NO-BLINK type starters. Fixture length: 48".

"DECIDEDLY BETTER"

FOR ALL COMMERCIAL AND INDUSTRIAL LIGHTING APPLICATIONS

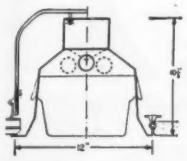
GLASS ENCLOSED TROFFERS



for two or three 40-watt lamps—single unit or continuous installations

Snap-in type for use with Tee-Bar construction and flange type for accoustical or plaster ceilings. Ribbed SKYTEX glass panels are rigidly supported in die-rolled frames with separable hinge device for easy maintenance. Interiors and all exposed trim rust inhibited and finished in HOT-BONDED SUPER-WHITE enamel. Equipped with safety fuse and wired with certified ballast (ETL approved), sockets, and NO-BLINK type starters. Fixture length: 48".

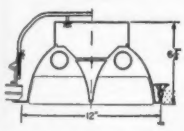
LATERAL LOUVERED TROFFERS



for one or two 40-watt lamps—single unit or continuous installations

Snap-in type for use with Tee-Bar construction and flange type for accoustical or plaster ceilings. Individual louvers easily installed or removed. All exposed parts rust inhibited and finished in HOT-BONDED SUPER-WHITE enamel. Wired with certified ballast (ETL approved), sockets, and NO-BLINK type starters. Fixture length: 48".

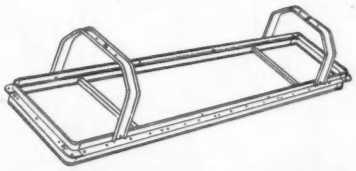
DIFFUSE ALZAK ALUMINUM TROFFERS



for two 40-watt lamps—single unit or continuous installations

Snap-in type for use with Tee-Bar construction and flange type for accoustical or plaster ceilings. Parabolic design engineered for accurate control of light distribution with low brightness ratio. Entire louver assembly can be easily installed or removed. Wired with certified ballast (ETL approved), sockets, and NO-BLINK type starters. Fixture length: 48". Also available in all-white finish.

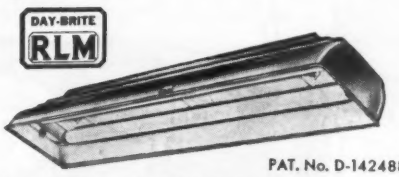
PLASTER FRAMES FOR FLANGE TYPE TROFFERS



with suspension straps 7⅝" or 11¼" deep—

Specifically engineered for simplifying installation of Day-Brite troffers in plaster ceilings. Side rails furnished in 12" and 48" lengths, complete with coupling fittings. End pieces include angles for attachment to side rails. Spacer bars are removable after plastering is completed.

INDUSTRIAL FIXTURES

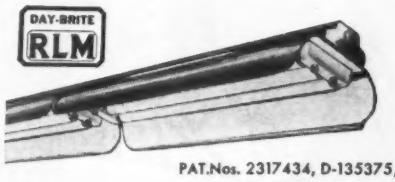


PAT. No. D-142488

the TUR-A-TOP*

open or closed end reflectors—for two or three 40-watt or two 85-watt lamps—single unit installations—chain or pipe suspension

Fixture housing is of turret-type construction, die-drawn from one piece of steel and finished in HOT-BONDED aluminum gray enamel. Both types of reflectors are of steel, finished in vitreous porcelain enamel, white inside and gray outside. Reflection factor is 82% or more. Reflector fastens to body by two captive wing nuts having a 2" diameter bearing surface . . . rigid foolproof fastening . . . easy servicing. Wired with certified ballast (ETL approved), TURRET* sockets, and NO-BLINK type starters.

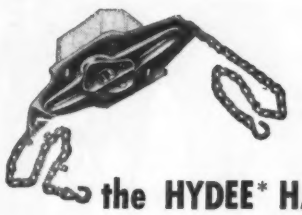


PAT.Nos. 2317434, D-135375, D-133458

the DAY-LINE*

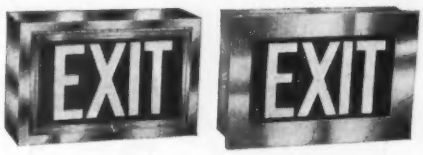
open or closed end reflectors—for two or three 40-watt or two 85-watt lamps—single unit or continuous installations—pipe, chain or cable suspension

Die-formed heavy gauge steel. Reflectors finished in porcelain enamel, reflection factor is 79% or more. Reflectors fasten to channel by two extra large captive wing nuts . . . easy removal without tools. Channel finished in HOT-BONDED aluminum gray enamel. Wired with certified ballast (ETL approved), vibration-proof TURRET* sockets (on all 40-watt sizes), and NO-BLINK type starters. Basic, Fill-in, and Alternate sections may be assembled to form continuous runs of any length. Mounting parts and accessories are available.



the HYDEE* HANGER

For hanging all chain suspension industrial units. Fits standard 4" or 3¼" outlet box or plaster ring. Self-grounding . . . allows use of two-wire cord and plug. Furnished complete including receptacle for two-prong plug, two 5-ft. chains, "S" hooks and cord clips. Hanger plate is finished in baked aluminum enamel. Underwriters Approved.



EXIT SIGNS

Flush and surface type, top or end mounting, triangular and suspended. Porcelain sockets for type "A" lamps, mounted on collapsible wireway for concealed and two-circuit wiring. Finish: Metallic Bronze Lacquer.

*T. M. REG. U. S. PAT. OFF.

IT'S EASY TO SEE WHEN IT'S

DAY-BRITE *Lighting*

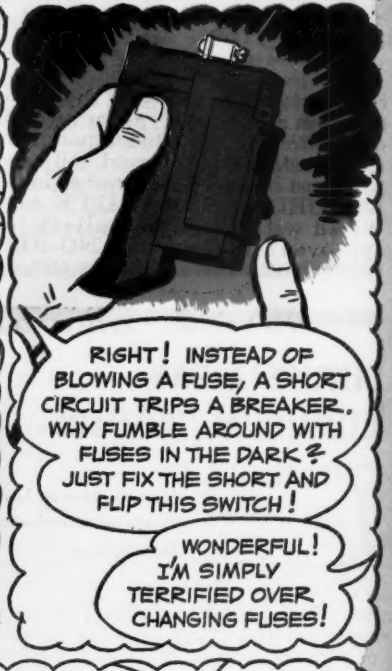
DISTRIBUTED NATIONALLY THROUGH LEADING ELECTRICAL WHOLESALERS

319

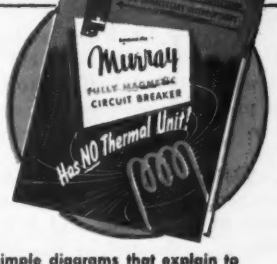
DAY-BRITE LIGHTING, INC., 5402 BULWER AVE., ST. LOUIS 7, MISSOURI

IN CANADA: AMALGAMATED ELECTRIC CORP., LTD., TORONTO 6, ONTARIO

WHAT! ME BID HIGH ON A JOB?



YOU, TOO, can reap extra profits from the inherent advantages of Murray *Fully Magnetic* Circuit Breakers. ASK YOUR MURRAY REPRESENTATIVE FOR DEMONSTRATION!



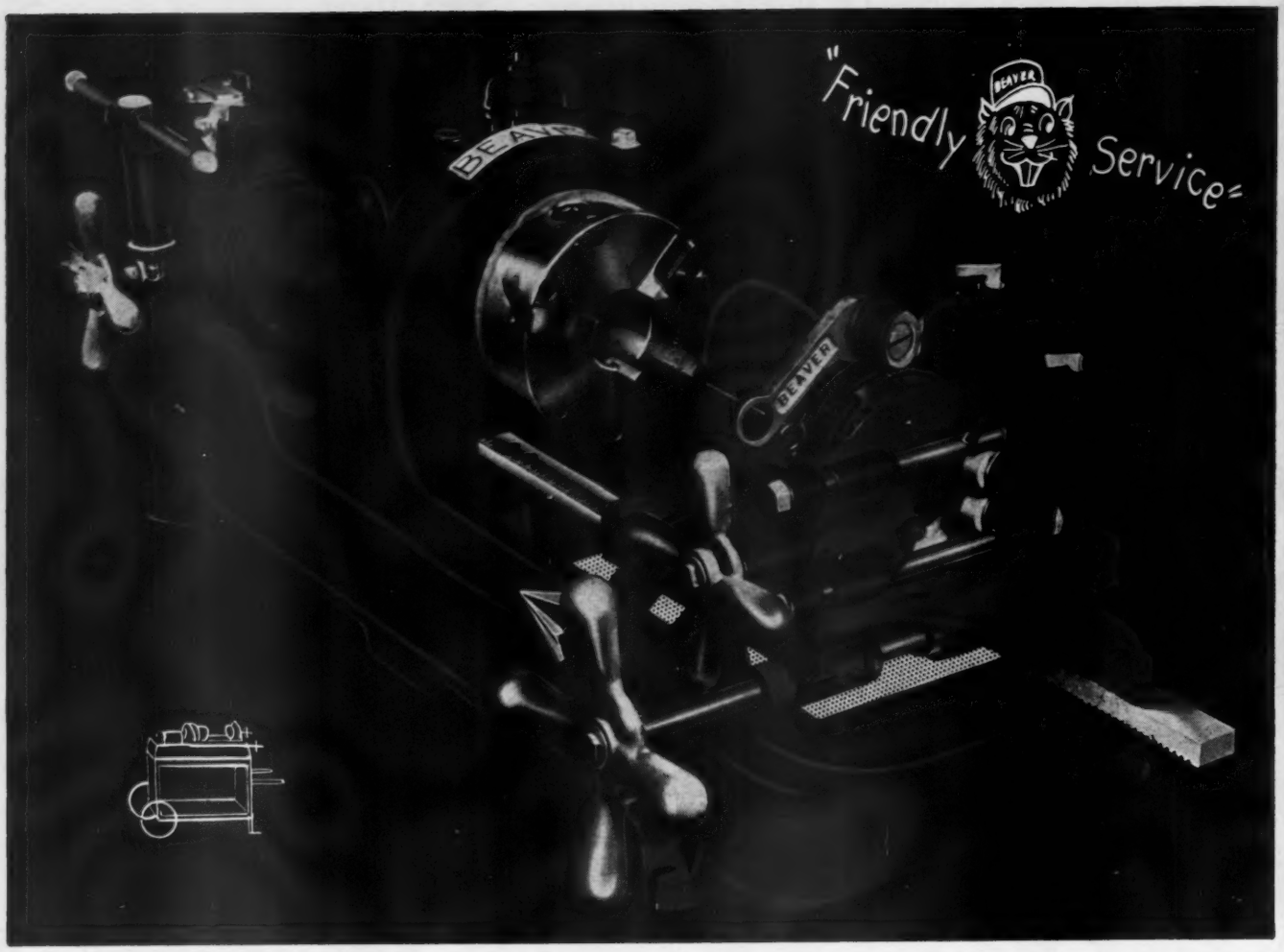
This folder contains simple diagrams that explain to architects, electrical contractors and home owners just how Murray *Fully Magnetic* Breakers afford dependable circuit protection without necessary interruptions. *Write for Your Copies Today!*

Murray MANUFACTURING CORPORATION

50 Years of Service to the Electrical Industry

1250 ATLANTIC AVENUE · BROOKLYN 16, NEW YORK

SERVICE ENTRANCE & METER EQUIPMENT · MAGNETIC CIRCUIT BREAKERS
SWITCHES · CURRENT LIMITING REACTORS · CROWS'NEST AERIAL LADDERS



THE BEAVER MODEL-B UTILITY PIPE & BOLT MACHINE

1. PERFORMANCE. The Beaver Model-B will cut, thread and ream ⅛ to 2" pipe. With a driveshaft and geared tools, 2½ to 8" pipe can be cut and threaded. It will thread ¼ to 1½" bolts and will cut off ¼ to ¾" bolts or solid rods with the wheel cutoff. It will thread steel, wrought iron, brass, copper, hard rubber, plastic or stainless steel pipe.

2. GENERAL FEATURES. Like a lathe, the Model-B is designed for right-hand operation—with all controls on the front at the fingertips. Has rack-and-pinion feed, with thirteen inches of open working-space—some competitive machines have less than six inches. Aluminum-alloy housings with renewable bronze spindle bearings. Net weight, 225 lbs. Base 18x36, height 13½". Has a ten-year record of excellent trouble-free performance in the hands of thousands of piping contractors, industrial plants, railroads, etc. Design and features protected by ten patents issued, others pending.

3. CUTOFF. Choice of self-centering, ball-bearing, wheel-and-roller cutoff which will cut off either pipe or bolts or an automatically-fed knife cutoff for cutting, beveling or grooving pipe. Wheel-and-roller cutoff standard equipment because of its greater speed, simplicity and utility.

4. THREADING. Choice of DUO-TYPE dies, threading two sizes, or MONO-TYPE dies, threading one size only. All dieheads quick-opening and fully-adjustable—no backing off. All dieheads calibrated for use with mono-type bolt dies, as well as pipe dies. The Beaver diehead is of "circular" design. There is no "hinge" to get fouled with fine cutting chips—causing off-standard threads to be cut. Beaver Models A and B Pipe Machines use the same dies—and it is well to remember that there are 186 different kinds and sizes carried in our $150,000 inventory of pipe machine dies. Always available are American and British pipe dies, right- and left-hand; National Coarse and Fine bolt dies, right- and left-hand; straight thread conduit dies; pump rod dies; Acme thread dies; etc. Be wary of those machines for which only a limited number of sizes of right-hand pipe dies are available to you!

5. REAMING. Drop-forged, cone-type reamer, conveniently hinged to swing in and out of position, is standard equipment on the Beaver Model-B.

6. MOTOR. Choice of 110/115, 220/230 and 240/250 volt Universal Reversible motor for use on electric light line, AC or DC, 25 to 60 cycle. Special voltage motors available for Model-A but not for Model-B. All gears fully enclosed and run in oil. Visual oil level gauge. Automatic Safety Switch Lock (patents pending) make it impossible to start motor with chuck wrench in the chuck. (This Switch Lock replaces former chuck wrench "ejector" which has the fault of ejecting only special types of wrenches.)

7. CHUCK AND SPINDLE. Note the eccentric-spool pipe centering device and steady rest—detached from the spindle. This is a patented Beaver feature and is important because the "detached" steady rest prevents the whip of long lengths of revolving pipe from rocking the spindle, causing bad threads and premature bearing wear. The chuck is a heavy-duty, full-size, full ⅛ to 2" range chuck of well known make.

May we send you new Beaver Catalog CC-49? Address Beaver Pipe Tools, Inc., 210-300 Dana Ave., Warren, Ohio, U. S. A.

BEAVER PIPE TOOLS

Three guideposts

TO BETTER

LIGHTING EQUIPMENT SPECIFICATIONS

1. 

The Fleur-O-Lier Index System for *Specifying* Lighting Performance for *Rating* Fluorescent Lighting Fixtures

2. 

Certified Starters for Modern Fluorescent Lighting

3. 
Certified Ballasts for Dependable Fluorescent Lighting

To Electrical Contractors, Architects and Electrical Consulting Engineers every modern lighting fixture installation demands the best features available. In fluorescent this means *Certified* Equipment.

The following pages present valuable information to those responsible for the selecting, specifying, installing and maintenance of modern fluorescent lighting systems.

The New FLEUR·O·LIER INDEX SYSTEM

THE GREATEST CONTRIBUTION TO LIGHTING SINCE FLUORESCENT!

● Fleur-O-Lier Manufacturers recently presented to the lighting industry — the Fleur-O-Lier Index System — a method of specifying, identifying, and classifying fluorescent luminaires — with regard to their illumination characteristics.

There's been a long-felt need for a system of classifying fixtures—some method common to all who make, sell, specify or buy fluorescent fixtures.

This is it—simple—practical —and basic.

Its purpose is two-fold.

1. It provides an exact formula which the specification writer may use to express the illuminating characteristics and performance he recommends.

2. It supplies a precise formula for fixture identification and classification that allows the buyer to know he's getting the illumination recommended.

Simplifies fixture identification.

Architects, lighting engineers, lighting consultants, lighting salesmen, contractors and utility lighting men . . . anyone who specifies or recommends lighting fixtures can use this simple, practical and fool-proof method to give an exact definition of the illuminating performance he selects for an installation.

Fixture Manufacturers will use the system to indicate the performance characteristics of their fixtures.

Buyers and users will employ this method of indexing to make certain they are getting what the specifier recommends.

FLEUR·O·LIER *Manufacturers*

Fleur-O-Lier is not the name of an individual manufacturer, but of a group of fixtures made by leading manufacturers. Participation in the Fleur-O-Lier program is open to any manufacturer who complies with Fleur-O-Lier requirements.

G-45-30-2-P

Here's an example of how

FLEUR·O·LIER INDEX SYSTEM *works*

In a specification, this number denotes the exact kind of lighting performance desired. "G" stands for General Diffuse lighting distribution; "45" for 45° side shielding; "30" for 30° end shielding; "2" for a brightness in shielded zone of not more than 2½ candles per square inch; "P" means Pendent mounting.

For a fixture, those symbols mean that Electrical Testing Laboratories, Inc., after photometric tests, find it has those performance characteristics.

Thus it is now possible for the specifier to express simply and precisely the lighting performance he wants. And the buyer can now buy fixtures and know in advance how they will perform when installed. For in addition to the Index System rating, complete photometric data, together with coefficients of utilization are supplied for each Fleur-O-Lier fixture.

And the Fleur-O-Lier label certifies that the fixture is "right" mechanically and electrically.

Fleur-O-Lier Gives Complete Information. All the data needed to make an intelligent choice of fixtures is provided by Fleur-O-Lier. You get—

1. **An Index System Rating**
2. **Photometric test data**
3. **Coefficients of Utilization**
4. **Certification**

You're sure when you insist on Fleur-O-Lier.

Here's how to get complete data—

The Fleur-O-Lier Manufacturers have prepared a booklet which explains the Fleur-O-Lier Index System completely . . . what it is and how to apply it. It's complete with tables. Use the coupon below to send for your free copy of the new booklet.

Fleur-O-Lier Manufacturers
2116 Keith Building
Cleveland 15, Ohio

Gentlemen:

Please send me a free copy of the booklet describing the Fleur-O-Lier Fixture Index System and containing the Fleur-O-Lier Specifications and Testing Procedures.

NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

are small—but *So IMPORTANT*

The starters in your fluorescent fixtures are small in size, but lamp life, starter life and overall maintenance costs depend on their efficient operation.

Certified Starters assure satisfactory performance because they're made to exacting specifications. And Electrical Testing Laboratories, Inc., an independent judge, tests and certifies that they conform.

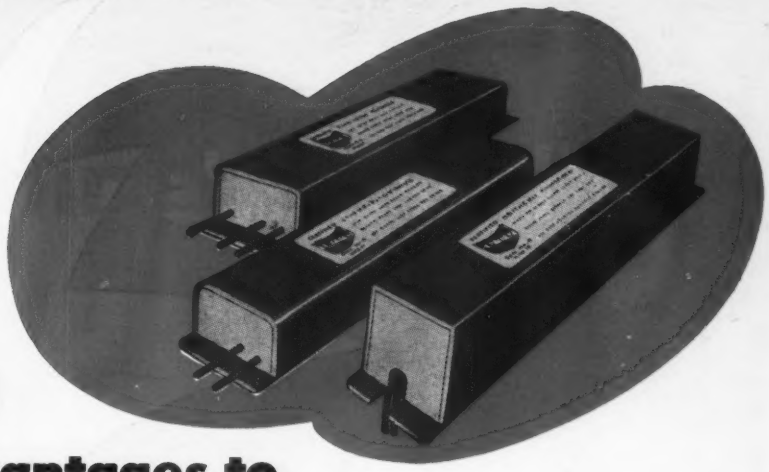
You'll like the way Certified Starters give satisfaction — appreciate the less frequent lamp and starter replacements.

CERTIFIED
E·T·L

To be sure you get Certified Starters, look for the Certified shield on the case and on each starter.

Certified Fluorescent Starter Manufacturers

2116 KEITH BUILDING • CLEVELAND 15, OHIO



BALLASTS

offer many advantages to

. . . the Manufacturer

. . . Contractor and Wholesaler

. . . the User

TO THE FIXTURE MANUFACTURER...

CERTIFIED BALLASTS mean satisfactory operation of tube and fixture . . . greater assurance that the complete fixture will be a trouble-free, more dependable product.

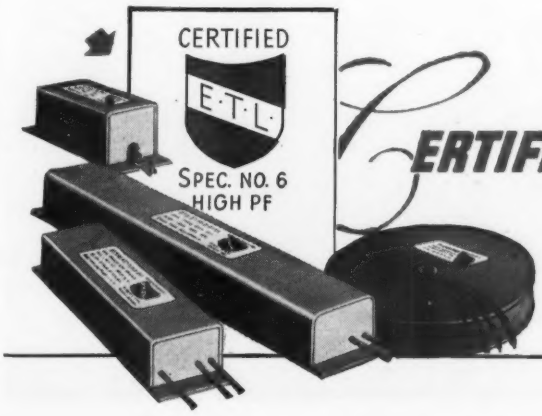
TO CONTRACTOR AND WHOLESALER

CERTIFIED BALLASTS build greater customer acceptance . . . provide protection for both himself and his customer . . . hold service worries to a minimum.

TO THE USER . . .

CERTIFIED BALLASTS assure the user of good lamp performance, good fixture operation, and a minimum of maintenance worries. Light-for-production, light-for-selling—and now light for living—depend on reliable day-in day-out service. That's why CERTIFIED BALLASTS are the sound, easy way to obtain dependable, long-life service from fluorescent lighting.

Thus—CERTIFIED BALLASTS provide specific advantages to an ever widening group of manufacturers, sellers and users. Furthermore, CERTIFIED protection now includes slimline tubes, and circular fluorescent tubes for portable lamps.



CERTIFIED BALLAST MANUFACTURERS

Makers of Certified Ballasts for Fluorescent Lighting

2116 KEITH BLDG., CLEVELAND 15, OHIO

for everything else, use

AMERBESTOS

WIRE AND CABLE

Asbestos, varnished cambric, asbestos and asbestos braid. Resists heat, flame, moisture, oil, grease and corrosive fumes and has high dielectric strength.

Typical all-asbestos construction. May be subjected to extreme heat, oil, grease, corrosive fumes.

Smokeless asbestos, for electric ranges, furnaces, and other heating appliances.

THE safest way to avoid trouble with "hot-spot" wiring is to use Amerbestos. In most applications around furnaces, boilers, ovens and even small lighting fixtures, *it gets hotter than you think.*

What would you guess to be the temperature inside a light socket on a hot day? It frequently reaches 200°F. or higher. Even the best rubber and thermoplastic insulations deteriorate when temperatures go that high. But what happens to Amerbestos insulation? Nothing. Felted asbestos as used in Amerbestos Wires does not deteriorate with heat. It retains its flexibility and its dielectric properties. Never grows hard nor brittle. It does not carry flame nor support combustion.

DON'T TAKE CHANCES

- If you design or install electrical wiring around furnaces, boilers or ovens—***use Amerbestos.***
- If you make electrical heating apparatus—***use Amerbestos.***
- If you make or install high wattage lighting equipment—***use Amerbestos.***
- If you design switchboards or control apparatus—***use Amerbestos.***

Let us help you guarantee dependable performance from your products with *permanent* Amerbestos insulation in cables, cords and wires. Amerbestos is made to resist heat, flame, moisture, oil, alkalis or corrosive fumes. For complete information or engineering help, write to any of the companies listed below.

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS **AMERBESTOS CABLES**

UNITED STATES STEEL

"During a power phase failure not one motor out of over 100 failed to clear itself... When power was restored we were ready to operate without a moment's loss in production"

"We believe you will be interested to know how well your Fusetron dual-element fuses protected our electric motors when we experienced a phase failure on our power circuit this past week.

"We have considerable obsolete 2 phase equipment in our plant but we are eliminating it as we go along. To protect these motors until the change-over, we had two choices: expensive thermal relays or Fusetron fuses. Naturally, we chose Fusetron fuses. From that time on, which is over two years, we have not lost one motor. Last week when the power phase failure occurred, not one motor failed to clear itself.

"Having over a hundred motors in the plant, we had a hatfull of blown fuses to replace but, when the power was restored, we were ready to operate without a moment's loss in production.

"Our past experience with Fusetron fuses proves that they will not blow needlessly — provided, of course, that the fuse rating is matched to the motor.

"We are using Fusetron fuses on our new machinery along with thermal protectors to prevent the machine operators from blocking the relay switches in the on position.

"Fusetron fuses are an absolute must on all electrical equipment in our plant."

Victor J. Kryst, *Maintenance Foreman,*
F. H. HILL COMPANY, INC.,
Cleveland, Ohio

Our Experience Proves

Facts About FUSETRON Dual-Element FUSES

The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

(FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

Fusetron DUAL-ELEMENT Fuses

Provide

10 Point Protection

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

Get all the Facts-Send the Coupon Now!

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

FUSETRON Dual-Element Fuses Give ALL-PURPOSE PROTECTION

One needless shutdown — or one lost motor — or one destroyed switch or panel — may cost you far more than replacing every ordinary fuse with a FUSETRON dual-element fuse.

Don't risk such losses — protect yourself by installing a FUSETRON dual-element fuse in every set of fuse clips throughout the entire electrical system.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City & Zone*_____ *State*___ EC&M-7-49

Introducing

THE

NEW

I-T-E Type ET 100 Amp. "F

Once again, I-T-E leads the way! This time with a new development in *molded-case* thermal breakers—the "F" Frame ET.

This all-new breaker is characterized by its varied application and operational flexibility; it's compact and simple. For power panels, panelboards, switchboards, individual mountings at service voltages of 600 V. a-c, 250 V. d-c, or under, you'll secure more dependable, longer-lasting protection with these new "F" Frame ET's.

FOR PANELBOARDS

Type ET 100 Amp. (thermal and fixed magnetic trip) "F" Frame Breaker, approved by U/L—for use in panelboards, power panels, switchboards and individual mountings.

FOR SHORT CIRCUIT PROTECTION ONLY

Type ETI 100 Amp. (adjustable-magnetic trip only) "F" Frame Breaker with external adjusting knobs for instantaneous trip setting of desired trip point. For use where short circuit protection only is required.

FOR ADJUSTABLE INSTANTANEOUS SETTINGS *PLUS* THERMAL PROTECTION

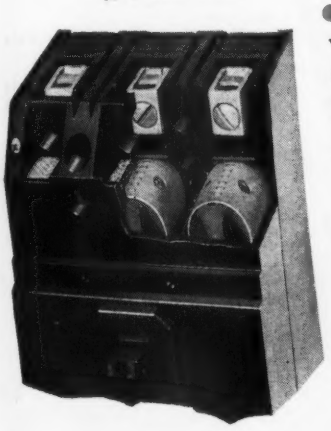
Type ETA 100 Amp. (thermal and adjustable magnetic trip) "F" Frame Breaker. This introduces a new variation in the I-T-E ET breaker line combining the thermal characteristics of the ET breaker and the adjustable instantaneous trip range in the ETI breaker. For use where an adjustable instantaneous trip range is desired in conjunction with thermal protection.

"F" Frame Thermal Circuit Breakers . . .

In no other thermal breaker will you find all of these features:

● **Greater Application Flexibility:** 14 combinations of auxiliary devices, including *internally-mounted* shunt trip and under-voltage trip features, auxiliary alarm switches, and field discharge switches.

● **Compactness:** 2-pole breaker is 3″ wide x 10″ high x $4\frac{27}{32}$″ deep, including handle. 3-pole breaker is $4\frac{1}{2}$″ wide x 10″ high x $4\frac{27}{32}$″ deep, including handle.



● **Enclosed Terminals:** (left) Offer protection when removing or inserting in switchboard applications and can be furnished for front removable or withdrawal type mounting.

● **Externally Adjustable Instantaneous Trip (ETI & ETA TYPES):** Now you can adjust the instantaneous trip setting without removing breaker cover. The "F" frame construction facilitates external adjustment of instantaneous trip points with three intermediate settings between the minimum and maximum tripping points.

● **Semi-Dust-Tight Enclosures:** (right) Nema Type I-A are available for "F" Frame Breakers. Operating mechanism is devised so that enclosure cover can not be opened unless breaker is in the open position.

● **I-T-E Quality:** Only in I-T-E circuit breakers do you secure the better design, more rugged construction, and more dependable protection that comes with engineering by *Switchgear Specialists.*

For your next thermal molded case breaker application, investigate I-T-E's new "F" Frame type ET circuit breaker. Complete catalog information is available now. Send for it today. I-T-E will be glad to supply you with the names of panelboard builders in your locality who will furnish panelboards equipped with I-T-E type ET breakers.

I-T-E R&IE *

THERMAL CIRCUIT BREAKERS

The Leader In Technical Excellence

I-T-E CIRCUIT BREAKER CO., 19th & HAMILTON STREETS, PHILADELPHIA 30, PA.
31 OFFICES IN UNITED STATES • In Canada, EASTERN POWER DEVICES Ltd., TORONTO

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • RESISTORS
AUTOMATIC RECLOSING CIRCUIT BREAKERS • SPECIAL PRODUCTS

*FOR POWER SWITCHING EQUIPMENT, REFER TO RAILWAY & INDUSTRIAL ENGINEERING CO., AN I-T-E ORGANIZATION

MONOWATT
INCORPORATED
A General Electric Affiliate
PROVIDENCE, R. I.

AND
COST-CUTTING

NEW Combination Devices Reduce

SWITCH, OUTLET and PILOT LIGHT COMBINATIONS

Made in combinations of four devices:—Single Pole and Three Way Switches, Outlets, and Pilot Lights in Brown and in Ivory.

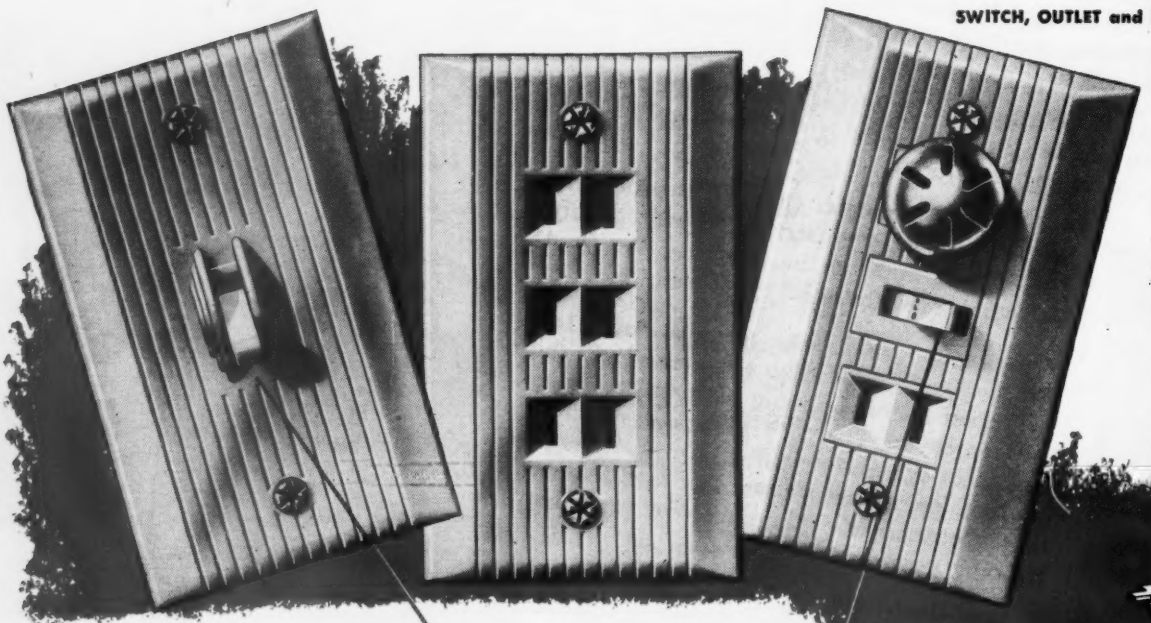
Cat. No. 4046—Pilot Light, Single Pole Switch, Outlet & Plate (illus.)

Cat. No. 4024—Two Single Pole Switches & Plate.

Cat. No. 4026—Single Pole Switch, Pilot Light & Plate.

Cat. No. 4041—One Single Pole Switch, Two Outlets & Plate.

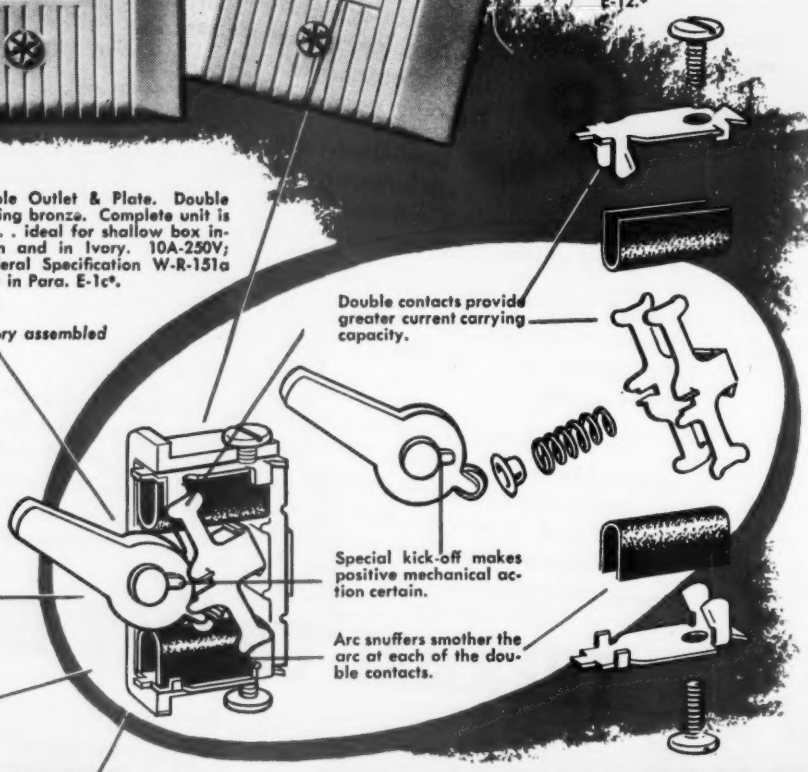
Switches "T" rated, 5A-250V; 10A-125V. Outlets, 10A-250V; 15A-125V. Pilot lights (6 watt lamp), 75W-125V. Meet Federal Specification W-S-893, except for technicality in Para. E-12.*

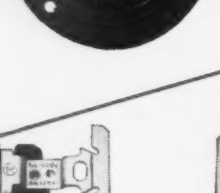


Cat. No. 1321—"T" Rated Single Pole Switch & Plate. **Cat. No. 1323**—"T" Rated Three Way Switch & Plate. In Brown and in Ivory. 5A-250V; 10A-125V. Meet Federal Specification W-S-896 except for technicality in Para. E-12*.

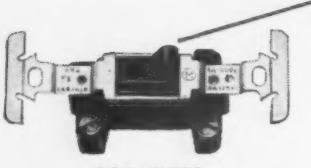
Cat. No. 1223—Triple Outlet & Plate. Double contacts of heavy spring bronze. Complete unit is less than 7/8" deep . . . ideal for shallow box installations. In Brown and in Ivory. 10A-250V; 15A-125V. Meet Federal Specification W-R-151a except for technicality in Para. E-1c*.

Requires a metal mounting strap. These devices are factory assembled on the plate to make a one-piece easy-to-install unit.



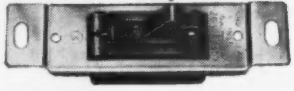


Cat. No. 1342—"T" Rated Single Pole Switch on Brown Plastic Cover. **Cat. No. 1344**—"T" Rated Three Way Switch on Brown Plastic Cover. Fit both 3¼" and 4" boxes. 5A-250V; 10A-125V. Meet Federal Specification W-S-890.



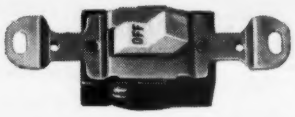
TOP-WIRED

Cat. No. 1314—"T" Rated Single Pole Switch. **Cat. No. 1315**—"T" Rated Three Way Switch. Removable Plaster Ears. In Brown and in Ivory. 5A-250V; 10A-125V. Meet Federal Specification W-S-896.



Cat. No. 1308—"T" Rated Single Pole Switch. **Cat. No. 1309**—"T" Rated Three Way Switch. Same quality as 1314-15 but without plaster ears. End-Wired.
In Brown and in Ivory. 5A-250V; 10A-125V.
Meets REA Specifications

LOW COST



Cat. No. 1301—Single Pole Switch. **Cat. No. 1303**—Three Way Switch.
In Brown and in Ivory.
5A-250V; 10A-125V

DON'T FORGET THESE DEVICES ARE SPECIFICATION GRADE

R&A

Both Device and Plate to one installation unit

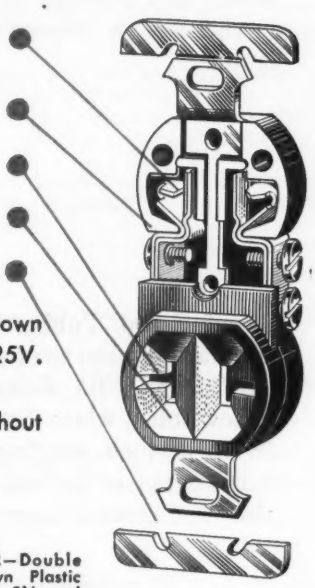
COST LESS TO BUY. You save about one-fourth the cost of separate devices of equal quality . . . you get three outlets at less than the cost of two.

COST LESS TO INSTALL. (1) Just two screws mount the complete unit. (2) Combining plate with device makes flush mounting automatic . . . eliminates adjustments. (3) Oval screw holes give ample leeway for squaring. (4) Fiber washers hold screws for quick mounting . . . prevent loss of screws and fumbling.

GIVE A BETTER JOB. Smart. Modern. One piece assembly of 1223 and 1321-23 eliminates dust catching space between device and plate.

DOUBLE OUTLETS *BUILT FOR SERVICE*

1. **Double-sided spring bronze contacts**
2. **Thick plastic housing**
3. **T-Slots**
4. **Modern functional styling**
5. **Removable plaster ears**



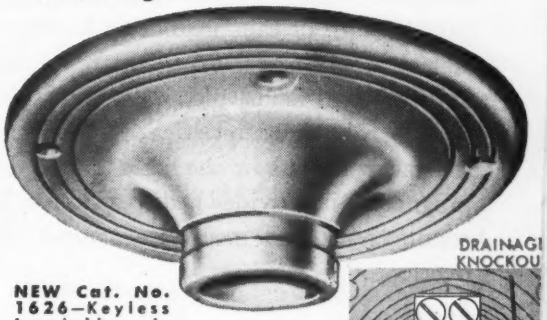
Cat. No. 1209 – Double Outlet. In Brown and in Ivory 10A-250V; 15A-125V.
Meet Federal Specification W-R-151a

Cat. No. 1208 — Same as 1209, without plaster ears.

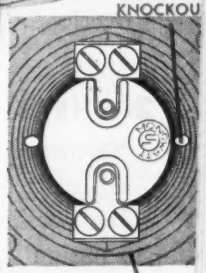
Cat. No. 1232—Double Outlet on Brown Plastic Cover. Fits both 3¼ and 4" boxes. "T" Slots. Double sided spring bronze contacts. 10A-250V; 15A-125V. Meets Federal Specification W-R-151a.

WIRING COSTS COME DOWN WHEN THESE GO UP!

These modern plastic ceiling lampholders are designed for speed in wiring plus dependability. There is no internal mechanism to fuss with, no porcelain ring to work loose or crack. Units fit both 3¼" and 4" boxes, cutting inventory requirements in half . . . weigh half as much as porcelain and are more resistant to chipping and cracking.



NEW Cat. No. 1626—Keyless Lampholder. In Brown and in Ivory. 660W-250V. Meets Federal Specification W-L-142.



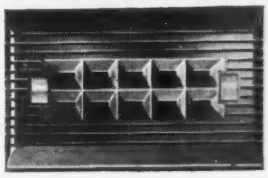
NEW . . . Double terminal screws for continuous wiring . . . eliminate soldering and taping. This feature, standard on duplex convenience outlets now available in a lampholder!

Cat. No. 1620—Pull Chain Lampholder. In Brown and in Ivory. 250W-250V. Meets Federal Specification W-L-142.

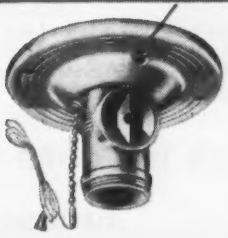
Modern design reduces wiring to a quick two-step job: (1) Secure code wire; (2) Screw unit to outlet box.

DEVICES FOR MODERATE PRICED JOBS

Cat. No. 1201—Double Outlet. In Brown and in Ivory. 10A-250V; 15A-125V.



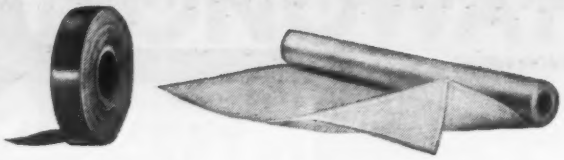
Cat. No. 1225—Five Outlet & Plate. Combined in one installation unit. In Brown and in Ivory. 10A-250V; 15A-125V.



Cat. No. 1612—Pull Chain Lampholder with Two Outlets. Lampholder, same quality as 1620; side outlets, with single contacts especially formed to grip plug blades firmly, not controlled by pull chain. In Brown and in Ivory. 250W-250V

Listed by Underwriters' Laboratories . . . but not Specification Grade

5 FACTS YOU SHOULD KNOW ABOUT THESE



VARNISHED CLOTH AND TAPE

1 WHAT THEY ARE

Fabrics woven of Fiberglas Continuous-Filament Yarns are impregnated and coated with high-quality varnishes to meet the increasing demand for a strong, flexible cloth or tape insulation having outstanding dielectric strength, excellent resistance to heat, moisture and acids, plus dimensional stability. All the inherent characteristics of an inorganic material are incorporated in the base fabric. Properly impregnated, it provides heat resistance, high thermal conductivity and insurance against the effects of overload.

2 WHERE THEY ARE USED

Varnished Cloth and Tape made of Fiberglas Yarn are used as transformer sheet insulation, coil and bus bar insulation, slot and end winding, phase insulation, cable wraps, etc. They are ideally suited for applications requiring heat resistance, high mechanical and dielectric strength, resistance to the effects of acids, oils and moisture . . . wherever greater protection against insulation failure is desired.

3 FORMS AVAILABLE

They are available in finished thicknesses of .003″ through .030″ in both sheet and tape form. Standard rolls of sheet material are supplied in 25, 50 or 100 lineal yards, 36″ wide. Standard tape rolls are 36 and 72 yards long in widths up to 6″ . . . bias cut tapes available in 51″ long strips. Black or yellow varnish.

SLEEVING AND TUBING

Saturated Sleeving and Varnished Tubing are made of Fiberglas Continuous-Filament Yarns, tightly braided and then saturated or coated with high-quality electrical varnishes to exceed minimum ASTM and the Varnished Tubing Association specifications for dielectric strength and heat endurance. Unusual flexibility, chemical resistance, mechanical strength and electrical properties are retained over wide temperature ranges to meet every application.

Sleeving and Tubing made of Fiberglas Yarn are used as coil and terminal insulation, in appliance wiring and coil-end insulation, phase connections —wherever a dependable, durable insulation is required.

Sleeving and Tubing are available in all of the standard grades, sizes and colors established by the ASTM and VTA. Colors: brown, black, red, green, yellow, blue, white. Standard lengths: Varnished—36 to 42-inch lengths; Saturated—36 to 42-inch cut lengths or in coils, depending on grades and sizes . . . several degrees of flexibility.

4 WHO MAKES THEM

Varnished Cloth and Tape, Saturated Sleeving and Varnished Tubing, made of Fiberglas Yarn, are produced by the leading manufacturers of electrical insulating materials.

5 WHO SELLS THEM

These products are sold by the manufacturers' electrical distributors and representatives. If you are unable to locate a supplier, call or write the Owens-Corning Fiberglas Corporation branch in your vicinity.

These products are but a few of the many available forms of Fiberglas-base electrical insulating materials. A copy of our new manual, "Fiberglas Glass-Base Electrical Insulating Materials," containing information on our complete line, will be sent on request. Owens-Corning Fiberglas Corporation, Textile Products Division, Dept. 856, 16 East 56 St., N. Y. 22.

YARNS FOR USE IN: CORD • TAPE • BRAIDED SLEEVING • CLOTH • LAMINATES

FIBERGLAS-BASE ELECTRICAL INSULATING MATERIALS

FIBERGLAS-BASE LAMINATES

These are materials possessing a desirable combination of insulating and mechanical properties produced by applying heat and pressure to layers of glass cloth or mat impregnated with, and bonded by, appropriate resins.

Phenolic Laminates. Mat and Cloth, made of Fiberglas Yarn, impregnated with phenolic resins . . . offer good physical properties, low moisture absorption and high dielectric strength . . . can be machined and punched.

Melamine Laminates. Glass Cloth impregnated with melamine resins . . . possesses high arc resistance, good dielectric strength with low moisture absorption . . . can be machined and punched.

Silicone Laminates. Glass Cloth and Mat impregnated with silicone, a thermosetting resin having very high heat stability . . . contribute to low dielectric loss factor and low moisture absorption.

Polyester Laminates. Mat and Cloth made of Fiberglas Yarn, impregnated with thermosetting polyester resins . . . good temperature resistance, electrical and mechanical properties . . . complex shapes possible with low-cost tooling . . . excellent machining and punching properties.

Fiberglas-base Laminates are used for panelboards, slot sticks, transformer spacers, switch bases, terminal strips and boards, insulating washers, coil forms, pole collars, arc shields, etc.

Phenolic Laminates. Used wherever above-average tensile, flexural, compressive and impact strengths combined with good electrical properties are required.

Melamine Laminates. Used where fire, arc and temperature resistance, and high impact strengths are important.

Silicone Laminates. Used in electrical apparatus where ambient or operating temperatures are excessively high and moisture conditions are severe.

Polyester Laminates. Used where above-average temperature resistance and physical properties are required . . . as an excellent general-application laminate material.

Phenolic: Sheets 36″ wide to 96″ long. Up to 2″ thick.
Tubes up to 6″ I. D. in 18″, 36″ or special lengths.
Rods up to 2″ diameter. Up to 36″ lengths.
Melamine: Sheets 36″ wide to 96″ long. Up to 2″ thick.
Tubes up to 1½″ diameter.
Rods up to 4″ diameter.
Silicone: Sheets 36″ to 46″. Up to 1″ thick.
Polyester: Sheets up to 36″ x 60″. ⅛″ to 1″ thick. Special shapes possible.

FIBERGLAS-MICA COMBINATION PRODUCTS

Fiberglas-Mica Combination Products are made by bonding layers of mica films on, or between glass cloth, or between glass cloth and paper, with either an organic or high heat-resistant (silicone) binder. This combination of Fiberglas fibers—with their great tensile strength and ability to withstand the effects of high temperatures and moisture—and inorganic, high dielectric mica, makes an ideal Class B insulating material. These Fiberglas-Mica Combination Products conform to the standards of the National Electrical Manufacturers Association on built-up mica flexible sheets and tapes.

Fiberglas-Mica Combination Products are used as ground or slot insulations in motors and generators, phase insulations, transformer coil insulations, coil wrapping tapes, end insulations, cable splices—wherever mechanical and electrical requirements are severe and the maximum safety factor is desired.

Mica combinations are available, with organic binder, in thicknesses from 5 to 35 mils. Special thicknesses can be provided on order. The glass cloth may be applied on both sides—facing thicknesses can be varied. Thinner products, in tape form, are sometimes made with very thin paper on one side and glass cloth on the other face. With silicone binder, the thickness ranges from 4 to 12 mils. Both types available in standard sheets 36″ square and in standard tapes.

Fiberglas-Base Laminates and Fiberglas-Mica Combination Products are made by leading manufacturers of electrical insulating materials.

*FIBERGLAS is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with glass fibers.

OWENS-CORNING
FIBERGLAS
ELECTRICAL INSULATING MATERIALS

VARNISHED CLOTH • SATURATED TUBING • MAGNET AND LEAD WIRE • MICA COMBINATIONS

BIG NEWS!

Sylvania enters low-cost fixture field with ... NEW ECONOMY MODEL EF-240

HERE'S important news for electrical contractors—a Sylvania Industrial Fixture in the lower price bracket! For the first time, you can offer your customers a Sylvania fixture comparable price-wise to any in the low-cost fixture field! Here are some important features of the new EF-240 Economy Model:

It's finished in Miracoat—the durable baked plastic finish used on higher priced Sylvania models.

Standard knockouts for easy conduit mounting.

Die-punched deep-drawn chassis makes spacing of lampholders positive in assembly of fixture and totally encloses high-power-factor ballast.

Price includes two 40-watt lamps and Glostat starters.

Cut-off is adequate for many industrial and home workshop applications.

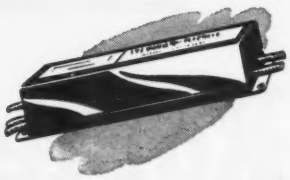
Completely wired—easy to assemble.

90-day guarantee of materials and workmanship.

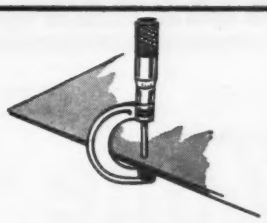
It's made by the makers of the famous HF-100.

LOOK AT THESE FEATURES

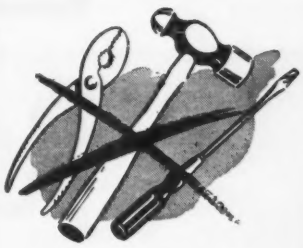
Reflector Efficiency is equal to, or *better* than, any comparable fixture on the market. Reflecting surface is Sylvania's exclusive Miracoat.



High Power Factor Ballast —85% or *better!* Ballast is totally enclosed in die-punched, deep-drawn steel chassis.

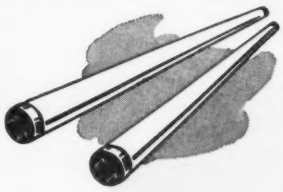


20-Gauge Steel Throughout — one piece chassis is deep drawn. Simple wing nut fastening of the reflector to the top housing.



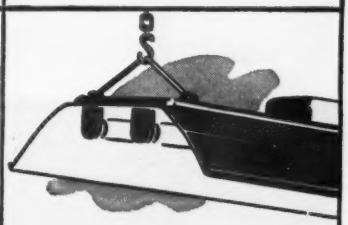
No Tools Required for easy maintenance of this fixture.

Underwriters' Laboratories Approved — The EF-240 carries the Underwriters' Laboratories seal of approval.



Sylvania's Long-Life Lamps are supplied—the finest fluorescent lamps money can buy. Longer life, more light than ever before.

Glostat Starters are standard equipment of the EF-240. These starters are Sylvania-made and give fast, reliable, long-lasting performance.



Hanging Ears, which are lanced-out, make it easy to attach unit to hanging device for regular industrial mounting.

Now is the time to get complete details of this revolutionary step in Sylvania's production. The EF-240 is a fine fluorescent fixture that will meet the requirements of a great many of your customers who desire a lower-priced unit. It is carefully designed to give dependable service. It has incorporated in it all the essential features expected in a fixture in this price range—*plus* many *exclusive Sylvania features* such as the Miracoat finish and one-piece chassis.

Send us the coupon below for complete details about the EF-240. In addition, we will gladly put you on our mailing list for all future Sylvania developments of interest to you.

mail coupon today!

SYLVANIA ELECTRIC

FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS; PHOTOLAMPS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

Sylvania Electric Products, Inc.
Department L-6007
500 Fifth Ave., New York 18, N. Y.

Gentlemen: Send me more information on the new EF-240. You may place me on your mailing list for information on future fixture developments.

*Name*_____

*Company*_____

*Address*_____

*City*_____ *Zone*_____

*State*_____

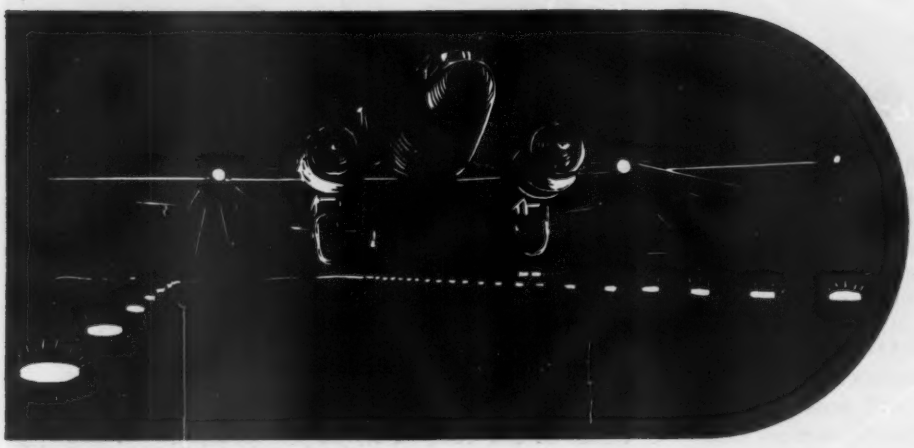
SPECIFY

RoMarine - RoPrene

and

RoZone - RoPrene

FOR AIRPORT WIRING



Now you can take all those airport wiring jobs—because here are cables approved by CAA for underground and conduit installations. Rome's cables have come through the rigorous tests of CAA and are now included in their "List of Approved Airport Lighting Equipment" for the two types covered by CAA Specification L-824 "Underground Electrical Cables for Airport Lighting Circuits".

ROMARINE-ROPRENE—the same Rome cable you have been using for service entrance and industrial power distribution is approved as Type A—Style RR for 600 volt service.

ROMARINE-ROPRENE for 3000 volt and 5000 volt duty is also approved under Specification L-824 as Type A and is now available.

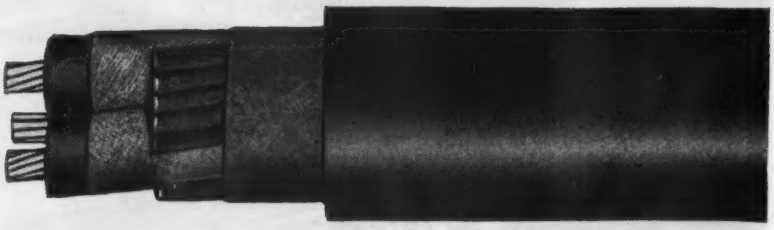
ROZONE*-ROPRENE—Rome's superior quality cable with ozone resistant insulation and Neoprene sheath is approved as Type B—Style ROR as single and multiple conductor cable with ozone resistant insulation and an overall polychloroprene sheath.

These approved Rome cables are now available in all sizes and types described by Specification L-824.

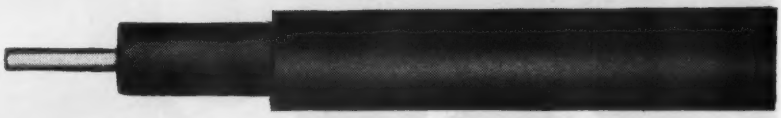
THE CABLES APPROVED BY CIVIL AERONAUTICS ADMINISTRATION UNDER SPECIFICATION L-824

Type A-Style RR Type B-Style ROR

Stranded 3 Conductor ROMARINE-ROPRENE cable. 3000 Volt Rating. (Type A Style RR)



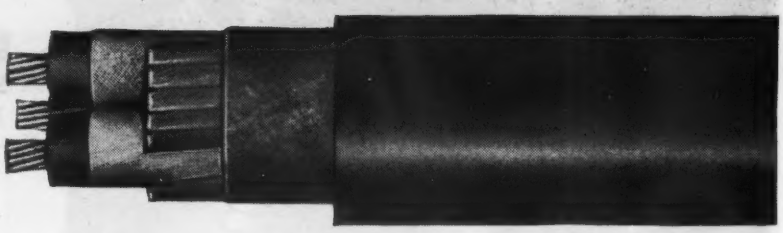
Solid Single Conductor ROMARINE-ROPRENE cable. 5000 Volt Rating. (Type A Style RR)



Stranded Single Conductor ROMARINE-ROPRENE cable. 600 Volt Rating. (Type A Style RR)

Stranded Single Conductor ROZONE*-ROPRENE cable. 3000 Volt Rating. (Type B Style ROR)

Stranded 3 Conductor ROZONE*-ROPRENE cable. 5000 Volt Rating. (Type B Style ROR)



*TRADEMARK REGISTERED

With an announced airport building and improvement program involving close to a billion dollars, there's real business ahead for you. You can get in on the ground floor now—get your share of this business—with the cables that have the required CAA approval. Specify ROMARINE-ROPRENE and ROZONE*-ROPRENE for those airport jobs.

FROM BAR TO FINISHED WIRE

ROME CABLE CORPORATION

ROME • NEW YORK

Get CORRECT CONDUIT CONNECTIONS

The easy economical way

Cross Section Showing Indentations

• NEATER • STRONGER • FASTER • APPROVED

All B-M Fittings Carry the Underwriter's Seal of Approval and Canadian Standards Ass'n Approval No. 9296

Select the best, insist on Briegel All Steel Fittings, the original approved Indenter type connectors and couplings for thin wall conduit tubing. You will not only find that Briegel Indenter Fittings are easier and faster to use, but also make neater, stronger connections, the correct connections. Two Easy Squeezes and they're set. Start using Briegel Fittings today. Have more satisfied customers—more profits from each job.

DISTRIBUTED BY

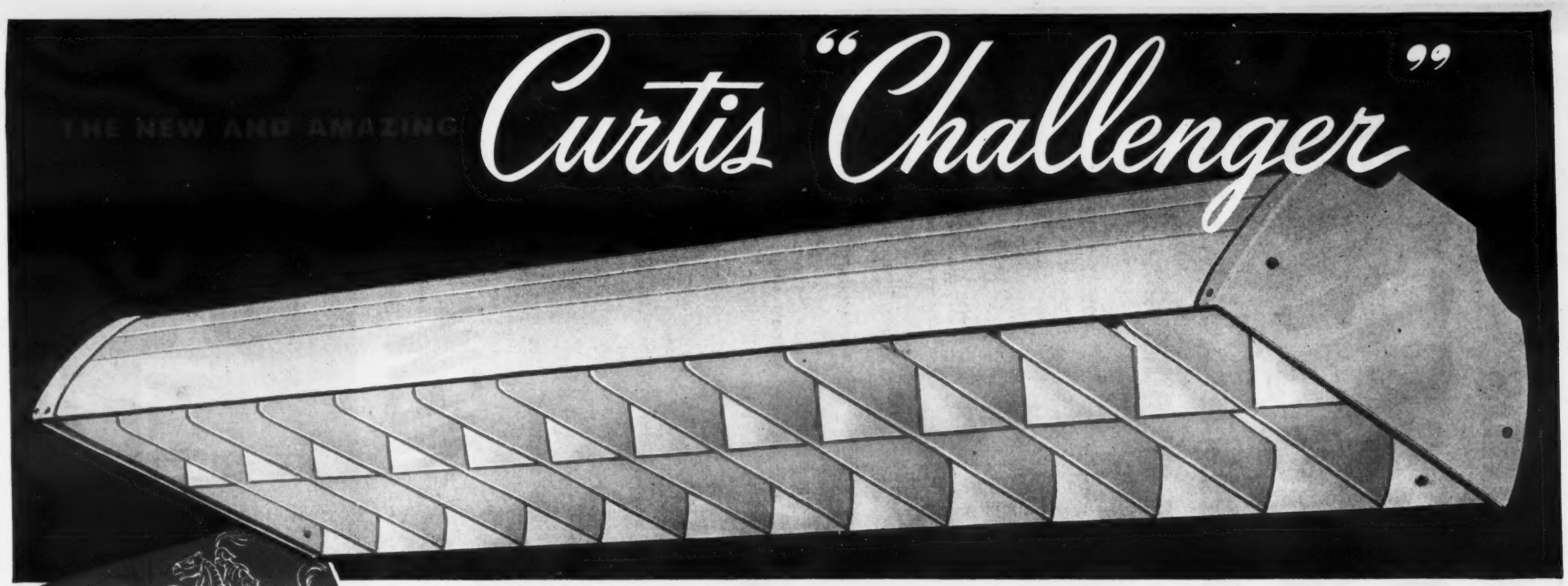
The M. B. Austin Co., Northbrook, Ill.; Clayton Mark & Co., Evanston, Ill.; Clifton Conduit Co., Jersey City, N. J.; General Electric Co., Bridgeport, Conn.; The Steelduct Co., Youngstown, Ohio; Enameled Metals, Pittsburgh, Penn.; Kondu Mfg. Co., Ltd., Preston, Ont.

BRIEGEL METHOD TOOL CO.

GALVA, • ILLINOIS

THE NEW AND AMAZING

Curtis "Challenger"



. . . ALL PREVIOUS STANDARDS FOR QUALITY . . . EFFICIENCY . . . INSTALLATION COST . . . MAINTENANCE COST . . . VALUE AND PRICE!

Now with the "Challenger" you can sell Curtis Quality . . . **at a new low price** . . . the very same quality, engineering and workmanship that has set the standards for the lighting industry for over a half century. Now with the "Challenger" you can sell Curtis Design and Efficiency . . . comparable to the best in the lighting industry at a price that will amaze your customer . . . and still bring you an attractive profit.

FOR FULL DETAILS *Send Coupon Today!*

SEND COUPON NOW!

Curtis Lighting, Inc.
6135 W. 65th Street, Chicago 38, Illinois

Gentlemen: Please send me FULL DETAILS and PRICES on the new "CURTIS CHALLENGER."

COMPANY NAME_____

ADDRESS_____

CITY & STATE_____

INDIVIDUAL'S NAME_____

NEW EDWARDS ADAPTABEL

Much Louder... Much Longer Life than any other bell at any price!

1. LOUDER & CLEARER... Adaptabel's tone is pure and penetrating—size for size, it's far louder than any bell now made. The 6" Adaptabel is more powerful than most 10" old-style bells!

2. FITS ALL MOUNTINGS... Adaptabel fits almost every standard conduit box, concealed or surface type. Mounting is equally simple in non-conduit work.

3. MECHANICALLY SUPERIOR... Radically new design (pat. pending) actually compensates for normal wear. No springs or contacts to adjust... no exposed mechanism or connectors to rust, corrode or collect dirt.

4. CHOICE OF TYPES... Edwards new Adaptabel is available in 4, 6 and 10" sizes —with voltages, as required, up to 250 volts, 60 cycles.

5. DIE-CAST HOUSING is made of "Z" metal... developed especially for use in expensive devices subject to extra-heavy strain or shock.

SIMPLE, ECONOMICAL INSTALLATION

1. Mount plate on wall or on any switchbox, outlet box, Condulet or Wiremold type fitting.

2. Connect wires. Large, convenient binding posts give plenty of working room.

3. Just slip Adaptabel on the sturdy hanger, then push home and secure with exposed screw. Job is finished.

NEW

EDWARDS ADAPTABEL

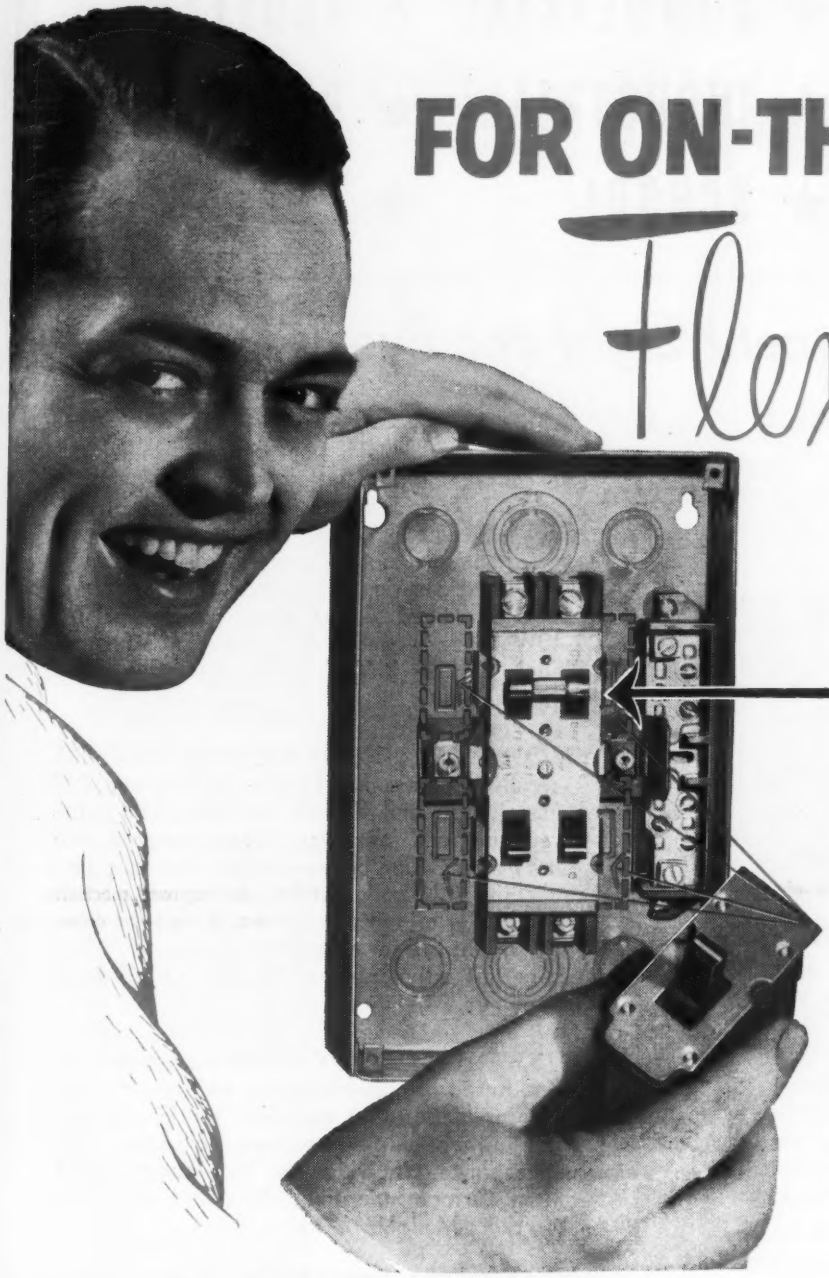
FOR FACTORIES, OFFICES AND SCHOOLS

WRITE TODAY FOR ILLUSTRATED BULLETIN

EDWARDS COMPANY, INC., Norwalk, Conn.

In Canada: Edwards of Canada, Ltd.

The Cutler-Hammer MB-4 Multi-Breaker



FOR ON-THE-JOB *Flexibility*

This is the
FUNDAMENTAL UNIT

The Cutler-Hammer MB-4 Multi-Breaker is fundamentally a standard 4-pole Multi-Breaker in an enclosing case. However, provisions have been made both in construction and space for additional single pole Multi-Breakers.

These are the units
ADDED ON THE JOB

The additional single-pole Multi-Breaker units can be added at any time . . . before, or at the time of installation or later, so as to make up the exact Multi-Breaker required by the job. Each additional unit slips into place and is secured by a screw.

The Cutler-Hammer Type MB-4 Multi-Breaker marks another big step ahead in modern electrical circuit protection. It is BIG news for contractors; equally BIG news for the wholesalers who supply them.

Now the contractor can make up just the Multi-Breaker he needs for each job. To the fundamental unit he simply adds from one to four add-on units as the number of circuits and their capacities dictate. Further, any of the add-on units can be changed on the job AFTER the complete Multi-Breaker is installed if the circuit requirements change; just a simple change, not a major operation. No delay. No trouble.

With the C-H Type MB-4 Multi-Breaker, the wholesaler can offer maximum service with minimum stocks, minimum investment, minimum inventory. He can furnish *exactly* the Multi-Breaker needed for *each* job without maintaining a large and complex assortment of complete Multi-Breakers incorporating the many combinations of breakers possible.

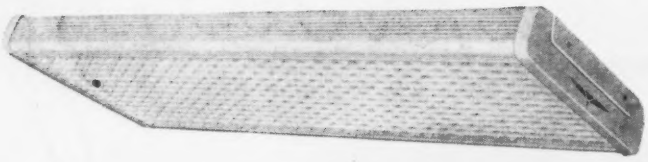
The Cutler-Hammer MB-4 provides Thermal-Magnetic trip for lag on harmless overloads but *instant* trip on short circuits. *Electronically* calibrated like all Cutler-Hammer Multi-Breakers for dependable performance. 70 ampere mains for small homes. 100 ampere mains for large homes. Breakers from 15 to 50 amperes. Underwriters' approved. Available in flush or surface mounting. CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wis.

CUTLER-HAMMER
MULTI-BREAKER
C-H

ELECTRO

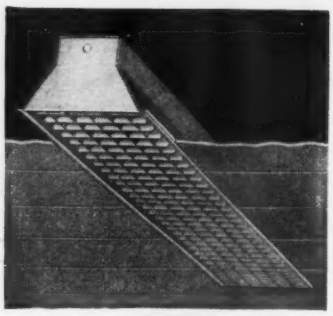
★ COMMERCIAL ★ TROFFER
★ INDUSTRIAL ★ RESIDENTIAL
★ SCHOOL ★ PORTABLE

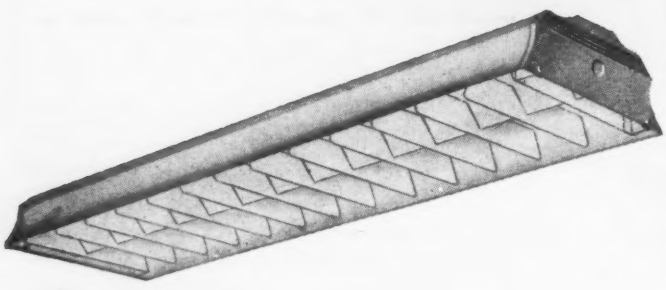
The Right Fluorescent Light for Every Purpose

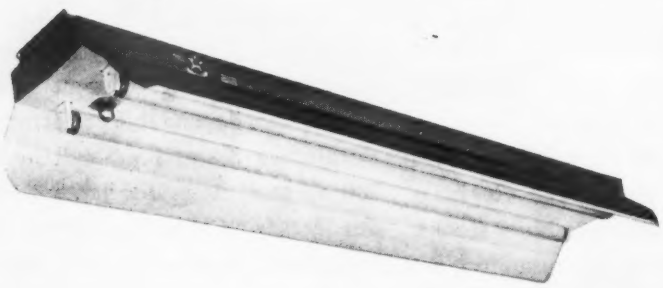


ALL ELECTRO FIXTURES

bear the Underwriters' Laboratory Label, the I. B. E. W. and A. F. of L. Union Label, as well as ELECTRO'S unconditional guarantee for workmanship and performance.







● SKYLOUVER — Available in 2-40W and 4-40W Louver or glass bottom. For individual and continuous installation, surface or pendant mounting. Exceptionally shallow—only 5⅛". Hinged Louver or glass panels provide easy, low-cost maintenance. Louvers and side panels of moulded plastic Polystyrene. Glass bottom panels of ribbed Skytex glass. Model #1025 2-40W Louver—Model #1045 4-40W Louver—Model #1026 2-40W Glass—Model #1046 4-40W Glass.

● COMPLETE LINE OF RECESSED TROFFERS —regular fluorescent and Slimline (T8 and T12 bulbs), 20, 30, and 40 watt, one lamp, two lamp, three lamp, and four lamp. Open, louvered, and glass bottom. Can be mounted overhead, T-bar, and Universal. In line and corner spot lite boxes available for all units. Louver and glass bottoms hinge downward for ease of maintenance. Hangers permit adjustment of fixtures to all types of ceilings.

● TWENTY TWENTY 2-40W for schools, offices, hospitals, banks, stores, restaurants, etc. Louver panel in one complete section—hinges from either side permitting low-cost, easy maintenance. Individual or continuous—pendant or surface mounting. Safe—all steel construction. Model #2020.

● COMPLETE INDUSTRIAL LINE including synthetic and porcelain enamel open and closed end reflectors. Available in two and three lamp 40 watt and two lamp 85 watt; four foot and eight foot sections. Also Slimline Industrials and Instant-Start Fluorescents.

● AVAILABLE in two and four light open luminaires, surface, and pendant mounted continuous and individual installations. Wafer-thin lending to modern streamline design. Starters easily accessible for ease of maintenance. Incorporates new ELECTRO Speedy Hanger. Model #1044.

ELECTRO MANUFACTURING CORPORATION
2000 W. Fulton Street Chicago 12, Illinois

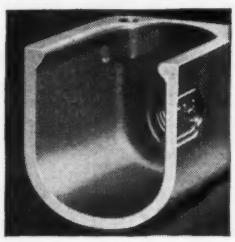
standardize on...

PYLETS

A Modern Line of Improved Heavy-Duty Conduit Fittings

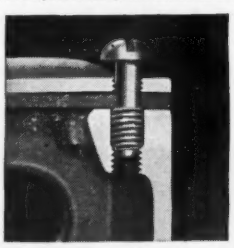
PYLET PRACTICAL DESIGN FEATURES

Accurate, malleable iron castings made in Pyle-National's own foundry. Double weather-proof protection—first, galvanized, and then finished with baked sprayed aluminum.



Smooth interiors, round edges and large wiring spaces prevent damage to wires. Ribbed sidewalls provide extra strength.

Strong Domed Covers are warped and Body Cover Joints are ground flat for tight gasket seal. Heavy hub sections of ample cross section are tapped straight and true with accurate, cleancut, TAPERED threads.

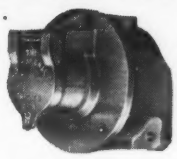


Dowl-pin type self retaining screws provide easy alignment of covers—hold cover and gasket together during handling.

A Full Range of Types and Sizes for Industrial Wiring

1

2



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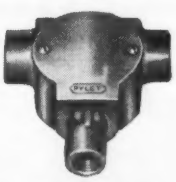

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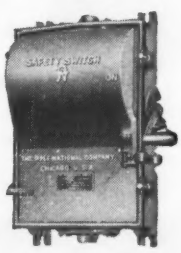


1. FS AND FD PYLETS AND COVERS—1, 2, 3 and 4 gang, square corner types, take all standard switch and receptacle plates.

2. ROUND BASE PYLETS AND COVERS—Ideal for Vaportight junction boxes—Flush and surface mounting. Take standard 4-inch outlet box cover; also vaportight fixtures, plug receptacles and Flexible fixture hangers.

3. VAPORTIGHT LIGHTING FIXTURES—With heavy cast metal bases, weathertight sealing and sturdy guards. Complete line, for 10 to 200 watt lamps, for conduit or wall mounting, universal 4 and 5 hub types, two and three gang, handrail and outlet box types, also midget fixtures.

4. FLEXIBLE FIXTURE HANGER PYLETS—Universal joint hub allows easy removal of fixture, free swing movement of fixture with stop to prevent wire injury, also cushion type for protection against vibration. Also rectangular Pylets with suspension hanger.

5. CAST METAL SAFETY SWITCHES AND CIRCUIT BREAKER PYLETS—Heavy duty safety switches and fuse boxes with or without plug receptacles and circuit breaker Pylets with all features for reliable service under severe conditions. Safety switches have quick make and break, interlocked cover and weathertight gaskets on both cover and hub plates. Available with interlocking plug receptacles.

Refer to your Pylet Catalog 1100 for complete listings including plugs and receptacles—explosion-proof pylets, cord and cable grips—flexible conduit couplings—unions—reducers—elbows and grip handles—portable hand lamps.

THE PYLE-NATIONAL COMPANY

1344 NORTH KOSTNER AVENUE, CHICAGO 51, ILLINOIS

DISTRICT OFFICES and REPRESENTATIVES in Principal Cities of the United States
EXPORT DEPARTMENT: International Railway Supply Co., 30 Church St., New York
CANADIAN AGENT: The Holden Co., Ltd., Montreal

SINCE 1897

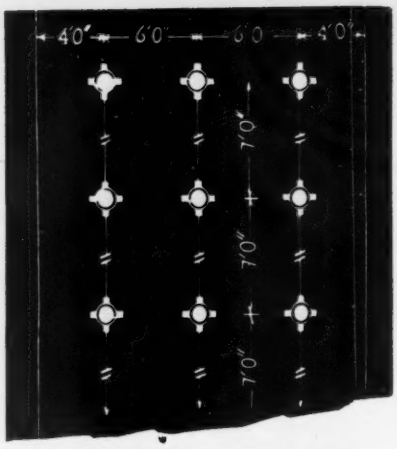
PLUGS and RECEPTACLES • FLOODLIGHTS • TURBO-GENERATORS • LOCOMOTIVE HEADLIGHTS • MULTI-VENT AIR DISTRIBUTION

FULLMAN *Electrical* PRODUCTS

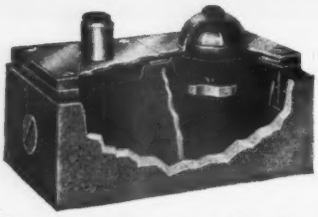
AVOID "OUTLET BOTTLENECKS" WITH "LATROBE" FLOOR BOXES

The building that you are designing, constructing, wiring or remodeling today may be occupied by an entirely different type of tenant a year from now . . . one requiring greatly increased lighting, power or low tension facilities. A liberal "spotting" of floor receptacle outlets *now* may save costly repair work *later*, and will suffice for the life of the building.

Such precautionary planning becomes even more justified in view of the easy and economical installation provided by "Latrobe" Adjustable Watertight Floor Boxes. These Fullman Manufacturing Co. boxes are made in single or gang combinations for receptacles, telephone service or other signals. They are simply constructed with minimum of parts making for extra-speedy installation. Made of finest materials to provide smooth, permanent service. Costs are cut and efficiency increased with "Latrobe" Boxes. There is a "Latrobe" Box to fit every individual requirement of every electrical plan and specification.

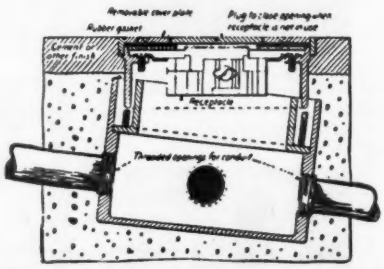


Indicate "Latrobe" Floor Boxes at close spacings to solve "Outlet Bottlenecks" for the life of the building.



NO. 252-R FLOOR BOX WITH NOS. 206 AND 207 NOZZLES

The 2-gang adjustable Floor Box is shown with No. 208 Receptacle in one section. One Cover Plate has ½" Flush Brass Plug and one has 2" Flush Brass Plug. Latrobe Gang Box Bodies are provided with solid partitions to separate high and low tension wires. Two, three and four Gang Boxes are drilled and tapered standard with ¾" conduit holes in sides and ends.



Easy to install and align with all types of finished floors. Readily accessible and never in the way when not needed.

NO. 110 WATERTIGHT BOX

The No. 110 Box is a neat appearing unit of simple construction. The No. 208 Receptacle shown, contains few parts and is designed for rapid, easy installation. The wireman simply attaches wires to the Receptacle, fastens on the Cover Plate and Receptacle is ready for use. No. 100—Used as a telephone outlet or junction box. Consists of iron box body, 3½ inch round brass cover plate and No. 206 Stem Nozzle. Furnished without stem nozzle if desired. Height 3⅛ in. from bottom of box to top of cover plate.

"LATROBE" UTILITY OUTLET

For use in wood floors, mantels, baseboards, show windows, and other installations free from moisture or mechanical injury. Can be quickly installed without marring the finish of the woodwork. It is only 2½" in diameter and 2" high and is fitted with 10 amp. 115 bolt Bakelite receptacle.

NO. 284 NOZZLE WITH NO. 200 COVER PLATE

Here we have the neatest and most compact Duplex Receptacle Nozzle on the market Shown with ½" Brass Pipe Extension. Can be furnished also with ¾" pipe extension.

Latrobe Nozzles are made in all types for use with "Latrobe" Watertight Floor Outlets including 30 amp. 2 and 3 wire Receptacle Nozzle, Duplex Telephone Nozzles, Bell and Stem Nozzles of various sizes and types.

NO. 150 "LATROBE" WATERTIGHT BOX

This Adjustable Floor Box has a No. 207 Nozzle and is furnished with No. 242 Cover Plate and large Adjusting Ring No. 215.

The No. 150 Box is neat, compact, efficient—recommended for use in fireproof floors with wood flooring finish.

All "Latrobe" Floor Boxes are quickly installed and dependable in operation.

WE ALSO MANUFACTURE

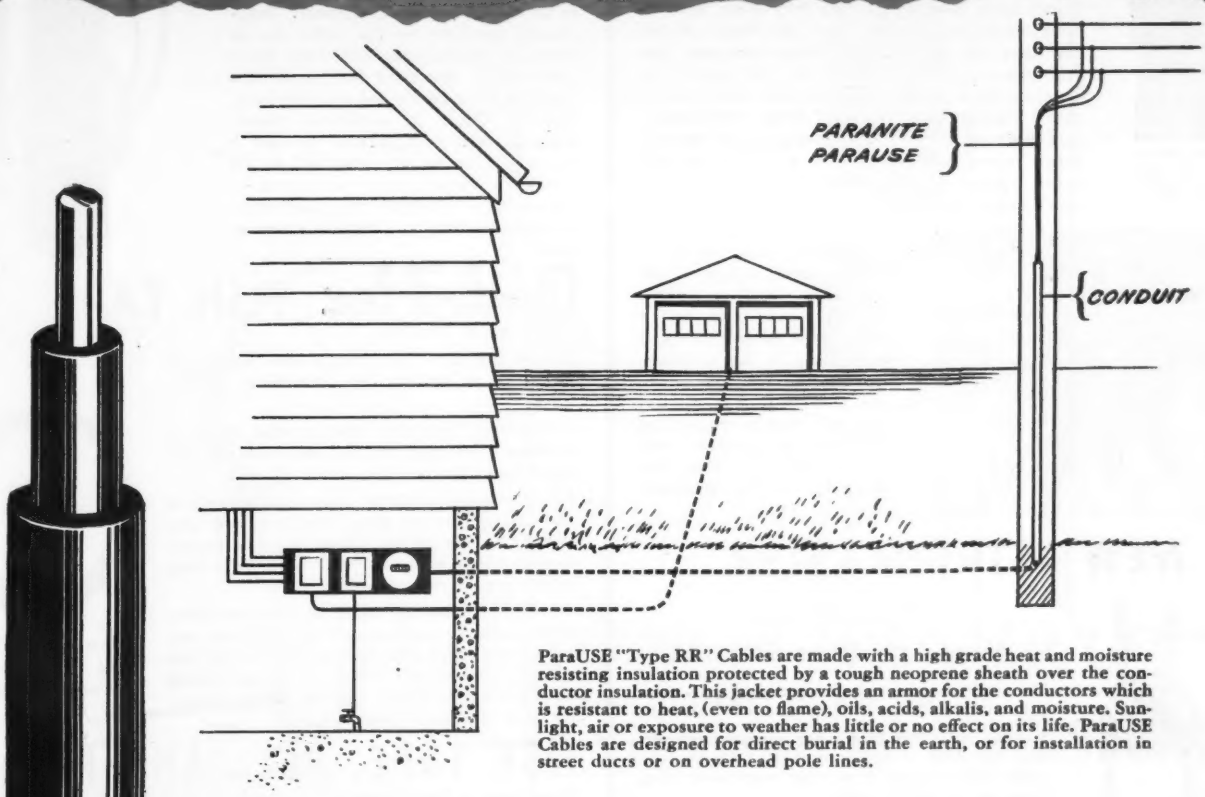
Insulator Supports
Conduit Benders
Pipe or Conduit Hangers
Armored Cable Supports
B X Cable Staples
Keystone Fish Wire

Warehouse stocks in eleven cities—write for catalog.

FULLMAN MANUFACTURING CO.

LATROBE . . . . . PENNSYLVANIA

THERE'S LESS OVERHEAD WHEN YOU USE THIS *UNDERGROUND*



ParaUSE "Type RR" Cables are made with a high grade heat and moisture resisting insulation protected by a tough neoprene sheath over the conductor insulation. This jacket provides an armor for the conductors which is resistant to heat, (even to flame), oils, acids, alkalis, and moisture. Sunlight, air or exposure to weather has little or no effect on its life. ParaUSE Cables are designed for direct burial in the earth, or for installation in street ducts or on overhead pole lines.

PARANITE "ParaUSE" CABLE "TYPE RR"

NON-METALLIC — NEOPRENE SHEATH

ParaUSE "Type RR" Parkway Wire and Cable provides economical permanent underground installation from power line to meter and for connecting several buildings from the same service. Examples of its application are on farms, estates and institutions, and for lighting streets, airports, ball parks, drive-in-theatres and many other outdoor lighting and power circuits.

It eliminates the trouble from sleet, windstorms and weathering. Unsightly outside wire is also done away with. You save labor. You save time. Simply dig a trench and cover; no other protection necessary.

IF IT'S **PARANITE** IT'S RIGHT!

DISTRIBUTED THROUGH WHOLESALERS

PARANITE WIRE AND CABLE

Division of ESSEX WIRE CORPORATION

FORT WAYNE 6, INDIANA

PARANITE TRADE MARK

WAREHOUSES* AND SALES OFFICES: *Atlanta, Ga.; Boston, Mass.; *Chicago, Ill.; Cleveland, Ohio; Dallas, Texas; *Detroit, Mich.; *Kansas City, Mo.; *Los Angeles, Calif.; *Newark, N. J.; Philadelphia, Pa.; *Portland, Oreg.; *St. Louis, Mo.; *San Diego, Calif.; *San Francisco, Calif.

ELECTRICAL WIRES AND CABLES *"BETTER THAN CODE REQUIRES"*

IDEAL WIRING TOOLS CUT JOB COSTS

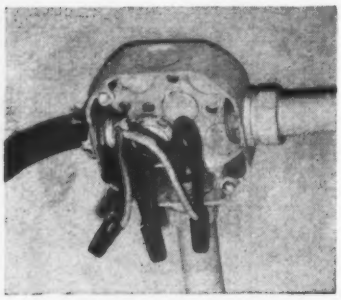
"WIRE-NUTS"

(Patented, No. 1,933,555)

Screws on—Like a nut on a bolt!

The best and cheapest way to make approved wire joints, IDEAL "Wire-Nuts" are now available at the lowest price in history.

For the past 20 years millions more IDEAL "Wire-Nuts" have been used than any other type of wire connector because they are *faster, better* and *they cut wiring costs. Faster*—because you just screw them on—that's all. No solder, no tape, no tools. *Better* because they make a joint that's stronger mechanically, better electrically, and more permanent. The precision-built spring-insert twists and threads the wire ends in one quick operation—assures a vise-like grip that can't pull or shake loose.



Bakelite plastic shell insulates and covers sharp wire ends. Built to highest precision standards in a brand new factory devoted exclusively to the manufacture of "Wire-Nuts". Every one inspected! For all circuit and fixture wiring, using wire combinations from two No. 18 up to three No. 10, solid and/or stranded.

NEW "STRIPMASTER"

(Patent Pending)

Hand-Type Wire Stripper

The world's easiest-to-use hand-type wire stripper. Gives faster "one-squeeze" operation . . . with revolutionary "automatic" feature that prevents crushing of wire. Takes only light finger pressure to strip wire clean and bare up to full ⅞ inch.

Jaws remain open while wire is removed—no crushing of wire, no nicked or frayed wire, no cut fingers—NO WASTE.

Just Insert Wire and Squeeze Handles

Just squeeze handles to strip—release grip and remove wire. Jaws *then* snap back, ready for the next strip. Takes less than 3 seconds! The "Stripmaster" fits in any size hand, weighs less than 10 ounces. Five models handle all wire gauges from 8 to 22. Blades are interchangeable; extra blades available.

JOIST BORING MACHINE

Five times faster and far easier. No back-breaking effort! No stoop, no strain, no ladder hazard. Does the job where no other tool can be used. Comes knocked down, less pipe, for quick assembly on the job. Adjustable (with proper pipe) for heights up to 12 feet.

CABLE RIPPER

Just squeeze onto cable and pull. For use on non-metallic sheathed cable or lead covered cable.

VOLTAGE TESTER

Gives double protection—this is not an ordinary 'Glo' tester! Includes both a solenoid voltage indicator on 110-600 volt calibrated scale and a neon test lamp. Completely eliminates the possibility of error and danger encountered in using old-fashioned methods. Easy-to-read numbers on the scale are in colors to correspond with fuse label color code. Machined test prods are 2 inches long. Leads are two feet long. Over-all length of attractive, plastic enclosed unit is 6 inches. Weight 8 ounces. Tests for all these: AC or DC circuits — blown fuses — grounds — frequency — polarity and continuity. Available with or without carrying case.

Coil-Flex FISH TAPE

(Patent Pending)

A new fish tape that speeds wire pulling in all kinds of conduit . . . including ALUMINUM!

Cuts wiring costs and quickly pays for itself because it lets you do twice the fishing in the same time without fatigue.

All "Coil-Flex" surfaces are round to reduce slide resistance and give a big, safe grip that is easy on the hands. Never kinks or snarls, never springs loose into "hot" wires or moving machinery.

Consists of a 25-foot length of .332-inch diam. steel spring wound around a rust-proof, aircraft-control type steel cable. Each length has a male fitting on one end and a female fitting on the other. Lengths can be quickly joined for jobs requiring longer tapes.

Factory inspected and tested at 400 pounds pull.

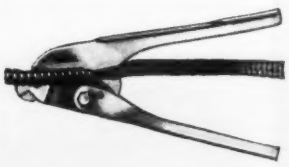
FISH TAPE, REEL AND PULLER

Three tools in one! Gives you the *big* pull you need when "fishing" wire and tape through long conduit runs. Reel acts as a handle, gives a sure, safe grip without bending, kinking or breaking the tape. Tape is fully enclosed—the end locked within the reel. May be run out to any desired length easily and quickly—reeled or unreeled and pulled through the conduit in one operation. Available in 5 stock sizes; lengths from 50 to 200 feet.

FISH TAPES

The "tried-and-true" standby of thousands of contractors and electricians. Made of highest quality tempered steel wire that won't snarl or kink. Exceptionally flexible for easy use on long runs of conduit having several bends. Seven sizes; lengths from 50 to 200 feet.

B-X ARMOR CUTTER



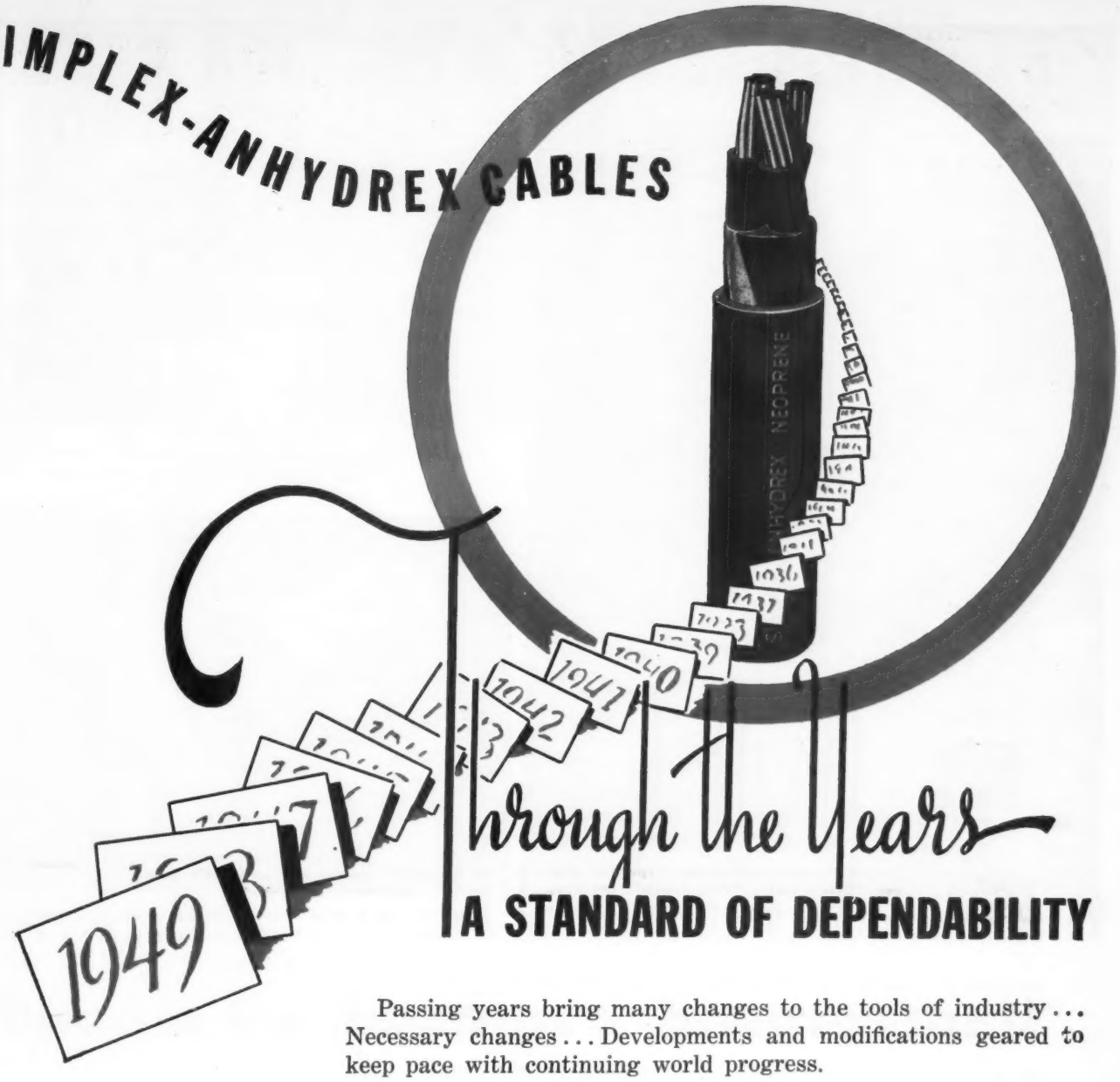
Makes B-X cutting easy! Just snip the cable, twist it and pull apart. Eliminates hacked and torn fingers —cut and damaged insulation. No other tool like it. Use it for either new small diameter or large diameter B-X, No. 10, 12, or 14 (two or three-wire) cable. Blade may be sharpened. End of tool serves as wire cutter. Extra blades available.

Sold Through America's Leading Distributors

IDEAL

IDEAL INDUSTRIES, Inc. Sycamore, Illinois

SIMPLEX-ANHYDREX CABLES



Through the Years—

A STANDARD OF DEPENDABILITY

Passing years bring many changes to the tools of industry... Necessary changes... Developments and modifications geared to keep pace with continuing world progress.

Simplex-ANHYDREX Cables have undergone just such changes.

Introduced to the electrical industry years ago as the first rubber-jacketed cables for burial directly in earth, they have ever since maintained leadership among underground cables.

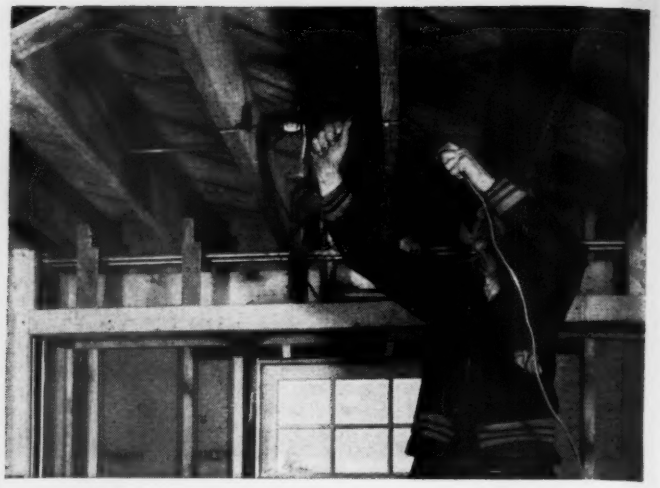
But improvements in design have extended that leadership! Today, ANHYDREX Cables are unexcelled as 3-way cables, providing low-cost, trouble-free service when buried in earth, installed in ducts, or used in aerial runs.

First in the past, first now, ANHYDREX Cables — backed by progressive Simplex research — promise to continue as the standard for comparison in the future. It will pay you to include them in your plans for tomorrow's power, communication, and signal circuits.

SIMPLEX-ANHYDREX

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS.

Insulated and sheathed with polyvinyl plastic, underground service cable needs no expensive braid or lead sheathing.



Polyvinyl plastic insulation won't propagate flame. Its excellent electrical properties insure extra protection.

Smooth surface and bright NEMA colors of polyvinyl plastic insulation permit easier installation, quick identification.

Underground, overhead, all around

. . . this modern house has wire insulated with polyvinyl plastic

JOB-WISE contractors specify *modern* wiring—*polyvinyl plastic insulated*—for *modern* homes because:

1. ***It has superior electrical properties*** **—permits thinner insulation—therefore more conductors per conduit.**
2. ***Saves time and money*—is smooth, easy to handle and install.**
3. ***Is tops in safety*—resists flame. Extreme toughness and abrasion resistance give added insurance against shorts.**
4. ***Is long-lasting*—not affected by sunlight, water, grease, oil, oxidation.**
5. ***Available in brilliant colors*—making hook-up and circuit tracing easy.**

It's easy to see why polyvinyl plastic makes superior electrical insulation for domestic, industrial or utilities wiring. Easy, too, to see why *Geon* polyvinyl materials lead the field—will continue to do so through constant research and improvement.

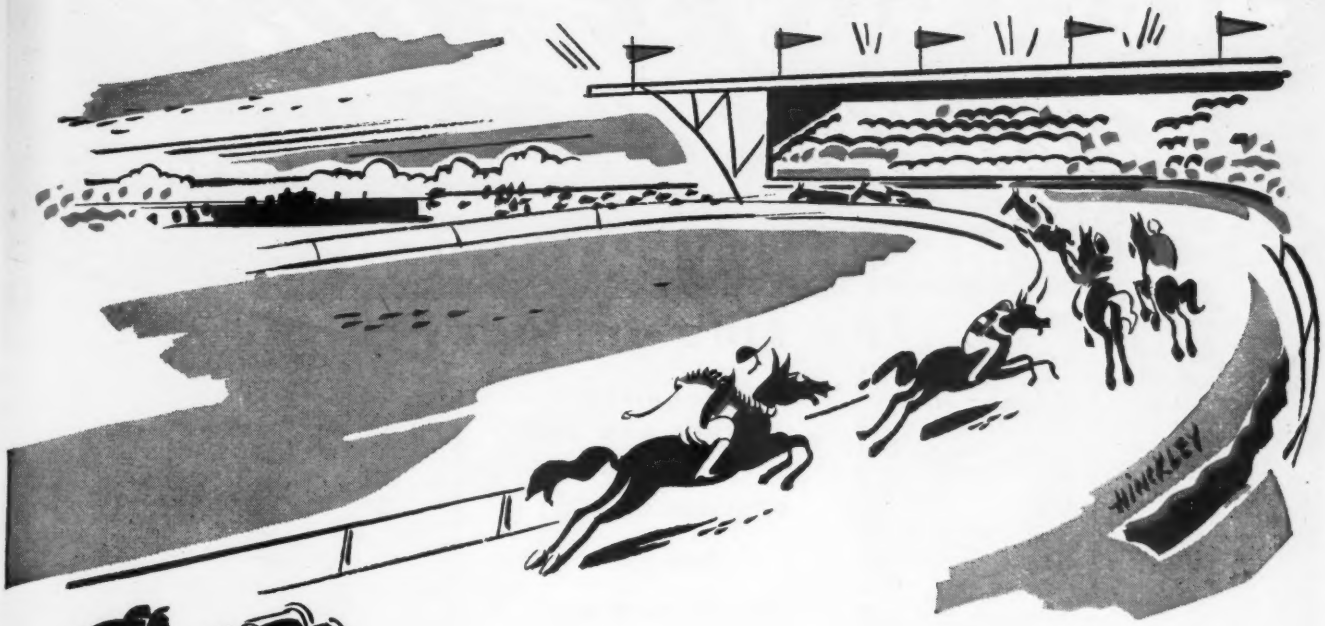
For all-around savings and safety, specify *polyvinyl plastic* insulated wire. If you have any special problems or applications, we'll gladly help. Please write Dept. EC-1, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers

YOUR CENTRAL RIGID STEEL CONDUIT DISTRIBUTOR MAKES YOU THE WINNER



CENTRAL
SPANS
CONDUIT

- You win two ways when you place an order with your Central Rigid Steel Conduit Distributor. You're sure of conduit of unexcelled quality that's easy to bend, cut or thread and that provides maximum safety in any location. And the complete stock of Central Black, Cenlaco and Central White Rigid Steel Conduit carried by your distributor, makes it easy for you to get exactly what you want without delay.

For fast delivery of conduit or other electrical supplies, call your Central Rigid Steel Conduit Distributor . . . and be a double winner.

SPANG-CHALFANT

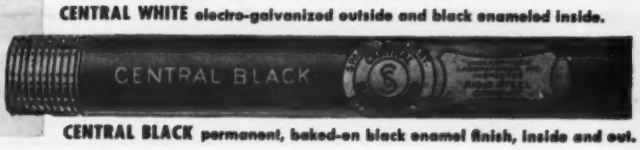
Division of The National Supply Company

General Sales Office: Grant Bldg., Pittsburgh, Pa.

District Offices and Sales Representatives in Principal Cities

CENLACO a hot dipped galvanized and lacquered finish, inside and out.

CENTRAL WHITE electro-galvanized outside and black enameled inside.



CENTRAL BLACK permanent, baked-on black enamel finish, inside and out.

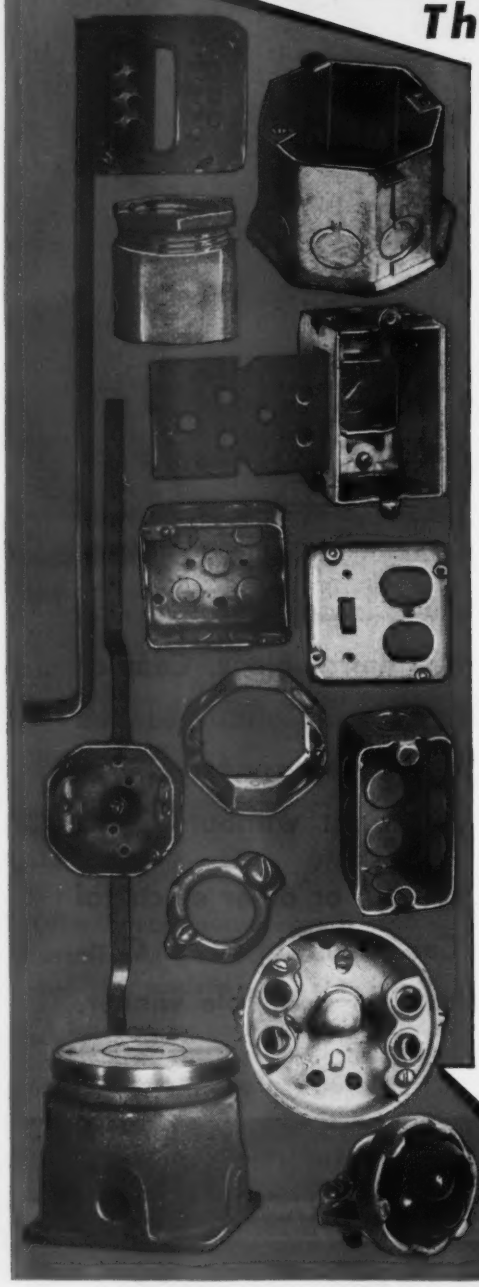
Steel City's Complete Line

of High Quality Boxes, Covers and Fittings Designed for Maximum Ease of Installation

MEETS EVERY NEED

The Line Includes

(In All Required Types and Sizes)



OUTLET BOXES AND COVERS

SWITCH BOXES

LOCKNUTS AND BUSHINGS

CONNECTORS

INSULATOR SUPPORTS

FLOOR BOXES AND ACCESSORIES

CONDUIT BENDERS

CAST IRON JUNCTION BOXES

SERVICE ENTRANCE FITTINGS

STRAPS AND STAPLES

GROUNDING FITTINGS

THREE-PIECE CONDUIT COUPLINGS

MARCHAND CLAMPS AND PLUGS

CAMPBELL BOXES AND ACCESSORIES

Steel City Leads in Meeting Your Needs

STEEL CITY ELECTRIC COMPANY

1207 COLUMBUS AVENUE, PITTSBURGH (12), PENNA.

Blazing a Trail for Profit

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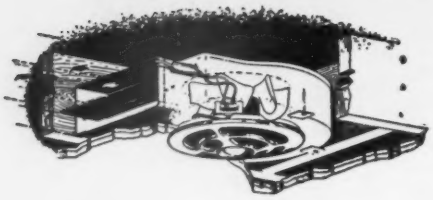
HENDERSON-HAZEL CORPORATION

5005 Euclid Avenue — Cleveland 3, Ohio

Blo-Fan*

CEILING "SPOT" VENTILATOR



When set between ceiling joists, Blo-Fan may be ducted either up thru roof or out thru side wall; or it may be set in a vertical wall, as back of the range. Requires only 3½" behind plaster. Has automatic damper. Elbow for ceiling-to-roof discharge; wall cap for exterior end of horizontal duct.

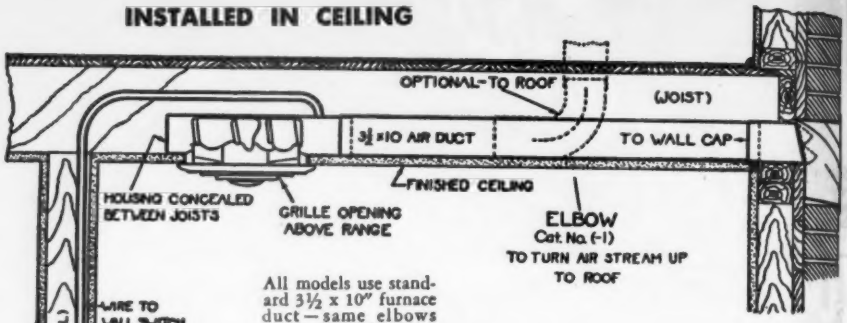
3 SIZES

No. 206 "JUNIOR" – for kitchenettes, small kitchens, bathrooms, etc.

No. 208 "STANDARD" – for average kitchens, laundries, small offices, etc.

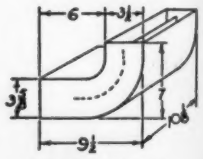
No. 210 "DELUXE" – for large kitchens, game rooms, etc. Equipped with 9 speed control.

INSTALLED IN CEILING



All models use standard 3½ x 10" furnace duct – same elbows – same wall cups

INSTALLED IN WALL
Since the Blo-Fan requires only 3½" recess behind the plaster, it may be placed in the wall without projecting into the room. Duct may be run up or down. This permits use in an inside wall behind the range, immediately below the cabinets.



ELBOW – (–1)
Contains auxiliary baffle to turn the air stream and keep the air from piling up against the outside.

THERE'S A Blo-Fan* DISTRIBUTOR

ALABAMA
BIRMINGHAM—Mayer Elect. Sup. Co.
MOBILE—McGowin-Lyons Hdw. & Sup.
MONTGOMERY—Teague Hardware Co.

ARIZONA
All Electrical Wholesalers

ARKANSAS
FORT SMITH—Interstate Electric Co.
HOT SPRINGS—F. C. Stearns Hdw. Co.

CALIFORNIA
All Electrical Wholesalers

COLORADO
DENVER—Central Electric Supply Co.
General Electric Supply Corp.

CONNECTICUT
BRIDGEPORT—General Elect. Sup. Corp.
B. M. Tower Co.
Olschan Elect. Sup. Co.
HARTFORD—American Elec. Sup. Co.
Beacon Light & Supply Co.
Economy Electric Supply Co.
General Electric Supply Corp.
NEW BRITAIN—Spring & Buckley, Inc.
NEW HAVEN—General Elec. Sup. Corp.
Grand Light & Supply Co.
NEW LONDON—United Elec. Sup. Co.
NORWALK—Mar Le Company
STAMFORD—Mar Le Company
WATERBURY—General Elec. Sup. Co.

DELAWARE
WILMINGTON—Art Craft Elec. Sup. Co.
General Elec. Sup. Corp.

DISTRICT OF COLUMBIA
WASHINGTON—Columbia Elect. Supply
Fries, Beail & Sharp Co.
General Electric Supply Corp.
Nathan Goodman Co.

FLORIDA
DAYTONA BEACH—Hughes Supply
FORT LAUDERDALE—McDonald Elec. Co.
GAINESVILLE—Baird Hardware Co.
Hughes Supply, Inc.
HOLLYWOOD—Atlantic Builders Serv.
JACKSONVILLE—General Elect. Supply
Raybro Electric Supplies, Inc.
MIAMI—General Electric Supply Corp.
McDonald Electric Co.
Raybro Electric Supplies, Inc.
ORLANDO—Hughes Supply, Inc.
PENSACOLA—Gulf Elect. & Hdw. Co.
ST. PETERSBURG—Raybro Electric Supp.
Hughes Supply, Inc.
TALLAHASSEE—McGowan Elect. Sup.
TAMPA—General Elect. Supply Corp.
Raybro Electric Supplies, Inc.
WEST PALM BEACH—McDonald Elect. Roofing & Sheet Metal Sup.

GEORGIA
ALBANY—Townsend Electric Sup. Co.
ATLANTA—Electrical Wholesalers, Inc.
General Electric Supply Co.
The Electric Supply Co.
Noland Company, Inc.
AUGUSTA—Hart Electric Supply Co.
COLUMBUS—P. & W. Electric Supply
DALTON—Dalton Supply Co.
MACON—Lowe Electric Co.
SAVANNAH—General Electric Supply Corp.

IDAHO
BOISE—General Electric Supply Corp.

ILLINOIS
AURORA—Schomer Electric Supply
CENTRALIA—Travelectric Co.
CHICAGO—Emjay Builders Supply Co.
General Electric Supply Corp.
Revere Electric Supply Co.
DANVILLE—Danville Elect. Supply Co.
ELGIN—Fox Electric Supply Co.
JOLIET—Barrett Hardware Co.
KANKAKEE—Schomer Elect. Supply Co.
PEORIA—Kiefer Electric Supply Co.
QUINCY—Crescent Elect. Supply Co.
ROCKFORD—General Elec. Supp. Co.
Englewood Elect. Supp. Div.
SPRINGFIELD—General Electric Supply

INDIANA
ANDERSON—Peerless Electric Co.
EVANSVILLE—General Elect. Supp. Co.
FT. WAYNE—General Elect. Supply Co.
National Mill Supply Co.
HAMMOND—General Elect. Supply Co.
INDIANAPOLIS—General Elec. Supply
Peerless Electric Supply Co.
LAFAYETTE—Kirby Risk Supply Co.
MARION—Universal Electric Co.
MUNCIE—General Electric Supply Co.
Universal Electric Co.
SOUTH BEND—South Bend Electric Co.
TERRE HAUTE—Walker Electric Supply

IOWA
BURLINGTON—Crescent Electric Sup.
CEDAR RAPIDS—Van Meter Co.
DAVENPORT—Crescent Electric Supply
DECORAH—Crescent Electric Supply
DES MOINES—General Electric Supply
DUBUQUE—Crescent Electric Supply
FT. DODGE—Iowa Electric Supply Co.
MASON CITY—Crescent Electric Sup.
OTTUMWA—Ottumwa Electric Supply
SIOUX CITY—Crescent Electric Supply
Rogers Electric Supplies
SPENCER—Crescent Electric Supply
WATERLOO—Crescent Electric Supply

KANSAS
SALINA—Electric Fixture & Supply Co.
Lee Hardware Co.
TOPEKA—Kansas Electric Supply Co.
WICHITA—American Electric Co.
Heaven Engineering Co.

KENTUCKY
LEXINGTON—General Electric Supply
LOUISVILLE—General Electric Supply
Tafel Electric & Supply Co.

LOUISIANA
BATON ROUGE—Electrical Wholesalers
MONROE—Monroe Hardware Co.
NEW ORLEANS—Eaco, Inc.
General Elect. Sup.
Lighting Fix. & Elec. Sup.
SHREVEPORT—General Electric Sup.
Interstate Electric Co., Inc.

MAINE
BANGOR—General Electric Supply Co.
LEWISTON—Lewiston Hdw. & Plumb.
PORTLAND—General Electric Supply

MARYLAND
BALTIMORE—Dorman Electric Supply
Excello Public Service Corp.
General Electric Supply Corp.

MASSACHUSETTS
BOSTON—General Electric Supply Co.
Mass. Gas & Electric Supply Co.
Ralph Pill Electric Supply Co.
BROCKTON—Mass. Gas & Elect. Sup.
CAMBRIDGE—EMF Electric Supply Co.
FALL RIVER—Brady Elec. Supply Co.
FITCHBURG—Service Electric Sup. Co.
HAVERHILL—Finberg Supply
LAWRENCE—Dyer-Clark Co.
Finberg Supply Co.
LYNN—Essex Electric Supply
MALDEN—Mass. Gas & Elect. Sup. Co.
NEW BEDFORD—Elect. Serv. & Sales
Mass. Gas & Electric Supply Co.
NORTH ATTLEBORO—Franklin Hdw. Co.
QUINCY—Granite City Electric Supply
SALEM—Silver's Supply Co., Inc.
SPRINGFIELD—Carlisle Hardware Co.
General Electric Supply Corp.
WALTHAM—Waltham Supply Co., Inc.
WATERTOWN—Mass. Gas & Elec. Co.
Watertown Elec. Sup. Co.
WORCESTER—Atlantic Electric Supply
General Electric Supply Corp.

MICHIGAN
BAY CITY—Meisel Hardware & Supply
BENTON HARBOR—West Mich. Elec.
DETROIT—Cadillac Electric Supply Co.
General Electric Supply Corp.
Madison Electric Co.
FLINT—Royalite Co.
GRAND RAPIDS—Electric Supply Co.
General Electric Supply Corp.
KALAMAZOO—General Electric Supply
Electric Supply Co.
MUSKEGON—Fitzpatric Electric Supply
The Electric Supply Co.
LANSING—General Electric Supply Co.
Michigan Brass & Electric Co.
PETOSKEY—Bremmeyr-Bain Co.
PONTIAC—Standard Electric Co.
SAGINAW—Morley Brothers
Standard Electric Co.

MINNESOTA
DULUTH—General Electric Supply Co.
MINNEAPOLIS—General Electric Sup.
Northland Electric Supply Co.
Sterling Electric Co.
ST. PAUL—Electric Supply Co.
Farwell, Ozmun, Kirk & Co.
General Electric Supply Corp.

MISSISSIPPI
JACKSON—Joe Williams Electric Sup.
General Electric Supply Corp.

MISSOURI
JOPLIN—General Electric Supply Co.
KANSAS CITY—General Electric Sup.
Glasco Electric Co.
Heaven Engineering Co.
SPRINGFIELD—Heaven Engineering
ST. JOSEPH—American Electric Co.
ST. LOUIS—General Electric Supply
Glasco Electric Co.
Teel Lighting Fixture & Supply

MONTANA
BILLINGS—General Electric Supply Co.
BUTTE—General Electric Supply Corp.
GREAT FALLS—Falls Supply Co.

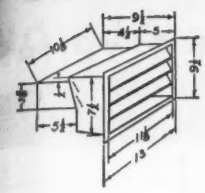
NEBRASKA
CHADRON—Casper Supply Co.
LINCOLN—Korsmeyer Co.
OMAHA—General Electric Supply Co.
SCOTTSBLUFF—Casper Supply Co.

NEVADA
LAS VEGAS—Standard Wholesale Sup.
RENO—Osborne & Kitchen, Inc.

NEW HAMPSHIRE
DOVER—Ralph Pill Electric Supply Co.
MANCHESTER—General Electric Supply
J. J. Moreau & Son, Inc.

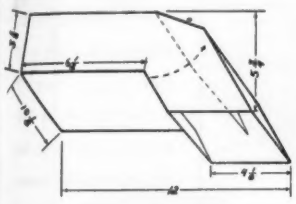
PRYNE & CO., INC. POMONA, CALIFORNIA

MORE THAN A FAN . . . MORE THAN A BLOWER



WALL CAP — (—2)

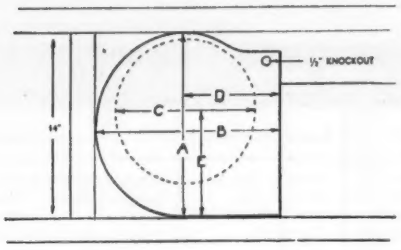
Scientifically baffled to offset headwinds. Contains two auxiliary automatic louvers to prevent cold from backing into duct.



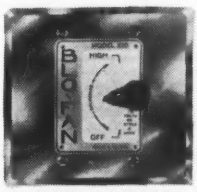
EAVE CAP — (—3)

Fits on end of horizontal Blo-Fan duct in the same manner as a wall cap, except that it discharges air down thru an overhanging eave. Contains an automatic back-draft louver, to prevent cold from backing into duct.

LOOKING DOWN ON HOUSING

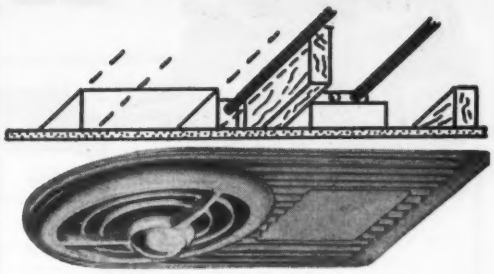


	A	B	C	D	E	Overall Dia. of Grille
No. 206	11¾	13¾	7⁹⁄₁₆	7½	7¹⁄₁₆	8
No. 208	14	16	9	8½	8	9½
No. 210	14	16	10¾	9⁹⁄₁₆	8	12



9 SPEEDS FORWARD

A new and exclusive nine position control switch is standard equipment on Model 210 Blo-Fan.



BLO-FAN WITH RECESSED LIGHT

Extremely popular because it provides a recessed light in conjunction with the ceiling ventilator. 100-watt light gives ample illuminaton for range below. Units serviced individually.

When used with No. 208 Blo-Fan, add " —408"
When used with No. 210 Blo-Fan, add " —410"

BLO-FAN SPECIFICATION DATA

Model	CMF†	Size	Speeds	Watts	With Elbow	With Wall Cap	With Light
206 "Junior"	175	11½x13¾x4¼	1	38	206-1	206-2	
208 "Standard"	300	14 x16 x4¼	1	58	208-1	208-2	208-408*
210 "De Luxe"	500	14 x16 x4¼	9	136	210-1	210-2	210-410*

* *If elbow or wall cap is desired also, add proper dash number.*
† *Actual cubic feet per minute discharge thru 10' of duct and a wall cap — NOT "FREE AIR."*

* Trade Mark Reg.

IN OR NEAR YOUR CITY

NEW JERSEY
ASBURY PARK—Rale Electrical Sup.
ATLANTIC CITY—Maegin Electric Sup.
BLOOMFIELD—Bloomfield Elect. Sup.
CAMDEN—Borstein Electric Co.
ELIZABETH—Jersey State Electric Co.
HACKENSACK—Lowenthal Elect. Sup.
HOBOKEN—L & G Laikin
MORRISTOWN—Morristown Elec. Sup.
NEWARK—Reliable Electric Sup. Co.
Star Electric Co.
NEW BRUNSWICK—N. B. Elec. Sup. Co.
ORANGE—C. M. Lantz
PASSAIC—National Electric Co.
Simon Brothers Electric Co.
PATERSON—Splvak Electrical Supply
White & Shauger, Inc.
PENNS GROVE—Serv-U-Electric Co.
PHILLIPSBURG—Warren Elect. Supply
PLAINFIELD—Hi-Fro Electric Sup. Co.
TRENTON—Griffith Electric Supply Co.
UNION CITY—Hudson Electric Supply
Oertell & Swift Co.

NEW MEXICO
ALBUQUERQUE—General Elect. Sup.
J. Korber & Co.
State Electric Supply Co.
SANTA FE—Santa Fe Builders Supply

NEW YORK
ALBANY—Havens Electric Co., Inc.
AMSTERDAM—Crane-Nevins Electric
BINGHAMTON—Gould-Farmer Co.
Wehle Electric Co., Inc.
BROOKLYN—G. M. Ketcham Mfg. Co.
BUFFALO—Davis Electric Supply Co.
General Electric Supply Corp.
Kenmore Builders Supply Co.
Wehle Electric Co., Inc.
ELMIRA—Wehle Electric Co., Inc.
GLENS FALLS—Glens Falls Electric
HICKSVILLE, L. I.—General Electric
ITHACA—Stallman of Ithaca
JAMAICA—Central Queens Elec. Sup.
JAMESTOWN—Pitts Corp.
Wehle Electric Co., Inc.
KINGSTON—Kolts Electric Supply Co.
MT. VERNON—B. Davis Co.
P. G. Supply Co.
NEW YORK CITY—General Elect. Co.
NIAGARA FALLS—General Elec. Sup.
Hirschfeld Electric Supply Co.
OLEAN—Le Valley-McLeod, Inc.
PEARL RIVER—Rockland Elec. & Sup.
PEEKSKILL—General Electric Supply
POUGHKEEPSIE—Electra Supply Co.
ROCHESTER—General Electric Supply
S. A. Spencer
Wehle Electric Co., Inc.
ROME—Griffith Electric Supply Co.
SCHENECTADY—LeValley-McLeod, Inc.
Dorp Electric
SYRACUSE—Edward Joy Co.
Gould-Farmer Co., Inc.
UTICA—H. D. Kulow
WATERTOWN—Halley Electric Co.
YONKERS—Goler Electric Supply Co.

NORTH CAROLINA
BURLINGTON—Womack Elec. & Sup.
CHARLOTTE—General Electric Supply
Union Supply & Electric Co.
GREENSBORO—Johannesen Elect. Co.
RALEIGH—General Electric Supply Co.
ROCKY MOUNT—Eastern Electric Sup.
WINSTON SALEM—Lambeth Electric

NORTH DAKOTA
BISMARCK—Dakota Electric Supply
FARGO—Dakota Electric Supply Co.
GRAND FORKS—Dakota Electric Sup.
MINOT—Dakota Electric Supply Co.

OHIO
AKRON—General Electric Supply Co.
Sacks Electric Supply Co.
CANTON—Furbay Electric Supply Co.
General Electric Supply Corp.
CINCINNATI—General Electric Supply
Richards Electric Supply Co.
CLEVELAND—General Electric Supply
Midland Electric Co.
COLUMBUS—General Electric Supply
Howard Bldg. Service Co.
COSHOCTON—Wagner's
DAYTON—General Electric Supply Co.
Martin Electric Co.
LANCASTER—Snyder Electric Co.
LIMA—Electric Supply Co.
TOLEDO—Anderson Supply Co.
General Electric Supply Corp.
YOUNGSTOWN—General Electric Co.
Hood Electric Co.

OKLAHOMA
MUSKOGEE—Fullerton Electric Supply
OKLAHOMA CITY—Cook Electric Co.
Elledge-Meyer Supply Co.
M & V Supply Co.
TULSA—Clark Electrical Supply Co.
Southern Electric Supply Corp.

OREGON
EUGENE—All Electrical Wholesalers
KLAMATH FALLS—Lorenz Co.
The Sloan Company
MEDFORD—Lorenz Company
PORTLAND—All Electrical Wholesalers
SALEM—All Electrical Wholesalers

PENNSYLVANIA
ALLENTOWN—Allen Electric Co.
General Electric Supply Corp.
BLOOMSBURG—E. R. Beers Elect. Co.
BRADFORD—Booth Elect. Supply Co.
CHESTER—Reddington Electric Co.
ERIE—Harley D. Carpenter
Erie Electric Supply Division
General Electric Supply Corp.
HARRISBURG—Dauphin Electric Sup.
LANCASTER—Jno. E. Graybill & Co.
MEADVILLE—Harley D. Carpenter
OIL CITY—Corrin Electric Supply Co.
PHILADELPHIA—Taylor Albertson Co.
Broad Electric Supply Co.
General Electric Supply Corp.
W. Phila. Electric Supply Co.
PITTSBURGH—L. Paul O'Hara
READING—General Electric Sup.
Silver Electric Supply Co.
SCRANTON—General Electric Supply
Lewis & Reif, Inc.
WEST CHESTER—West Chester Elect.
WILKES-BARRE—General Elect. Sup.
YORK—Jno. E. Graybill & Co.

RHODE ISLAND
PAWTUCKET—Equitable Electric Co.
PROVIDENCE—General Electric Supply
Royal Electric Supply Company

SOUTH CAROLINA
ANDERSON—Sullivan Hdw. Co.
CHARLESTON—Perry-Mann Elect. Co.
COLUMBIA—Perry-Mann Electric Co.
GREENVILLE—Sullivan Hdw. Co.
SPARTANBURG—Noland Company
Sullivan Hdw. Co.
SUMTER—Sumter Machinery Co.

SOUTH DAKOTA
ABERDEEN—Dakota Electric Supply
RAPID CITY—Casper Supply Co.
SIOUX FALLS—Crescent Electric Sup.

TENNESSEE
CHATTANOOGA—General Elect. Sup.
Ramsey Electric Supply Co.
KINGSPORT—Kingsport Elec. Co., Inc.
KNOXVILLE—General Electric Supply
MEMPHIS—General Electric Supply
Tenn. Valley Electric Supply Co.
NASHVILLE—Braid Electric Co.
General Electric Supply Corp.
Harris-Patrick Elect. Sup. Co.

TEXAS
ABILENE—General Electric Supply Co.
Sun Electric Co.
AMARILLO—General Electric Supply
Nunn Electric Supply Corp.
AUSTIN—Southern Electric Supply Co.
BEAUMONT—General Electric Supply
CORPUS CHRISTI—Corpus Christi Hd.
General Electric Supply Co.
DALLAS—General Electric Supply Co.
Meletio Electrical Supply Co.
Smith-Perry Electric Co.
EL PASO—General Electric Supply Co.
FT. WORTH—General Electric Supply
Smith-Perry Electric Co.
HARLINGEN—Bush Supply Co.
HOUSTON—General Elect. Supply Co.
Southern Electric Supply Co.
Warren Electric Co.
LUBBOCK—General Electric Sup. Co.
Southwestern Electric Sup. Co.
SAN ANTONIO—General Electric Sup.
Southern Electric Supply Co.
Southern Equipment Company
WACO—General Electric Supply Corp.

UTAH
SALT LAKE CITY—General Elec. Sup.
United Electric Supply Co.
Westinghouse Elec. Sup. Co.

VERMONT
BURLINGTON—Vermont Hardware Co.
RUTLAND—Oakman Electric Supply

VIRGINIA
ARLINGTON—Noland Company, Inc.
DANVILLE—Womack Electric & Sup.
LYNCHBURG—Mid-State Electric Sup.
NEWPORT NEWS—Noland Co., Inc.
NORFOLK—General Elect. Supply Co.
Goodman Electric Supply Co.
RICHMOND—General Electric Supply
ROANOKE—General Electric Sup. Co.
Noland Company, Inc.

WASHINGTON
BELLINGHAM—Bellingham Plmb. Sup.
SEATTLE—All Electrical Wholesalers
SPOKANE—Columbia Elec. & Mfg. Co.
General Electric Supply Corp.
Inland Electric Co.
Tubbs Electric Co.
Westinghouse Electric Sup. Co.
TACOMA—All Electrical Wholesalers
WALLA WALLA—Miller Supply, Inc.
Electric Supply & Fixture Co.
Westinghouse Electric Sup. Co.
YAKIMA—Westinghouse Elec. Sup. Co.

WEST VIRGINIA
CHARLESTON—Virginian Electric, Inc.

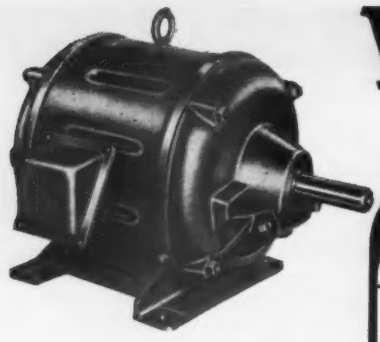
WISCONSIN
APPLETON—General Electric Supply
EAU CLAIRE—W. H. Hobbs Supply Co.
FOND DU LAC—Central Electric Sup.
GREEN BAY—Murphy Supply Co.
LA CROSSE—General Elect. Sup. Co.
W. A. Roosevelt Co.
MADISON—Crescent Electric Sup. Co.
MANITOWOC—Rahr's, Inc.
MILWAUKEE—Builders' Specialties, Inc.
General Electric Supply Corp.
OSHKOSH—Elect. Contractors Sup.
SHEBOYGAN—Honold & LaPage, Inc.

WYOMING
CASPER—Casper Supply Co.
CHEYENNE—Casper Supply Co.
LARAMIE—Casper Supply Co.
SHERIDAN—Casper Supply Co.
WORLAND—Casper Supply Co.

LOS ANGELES • SAN FRANCISCO • CHICAGO • NEW YORK

Wagner MOTORS

POLYPHASE



Wagner Motors are built in a wide range of standard models that includes those types most generally used on motor-driven appliances and equipment, and those types that meet the majority of industrial requirements. They embody the latest developments in design, are simple, rugged and dependable, and have long life in addition to good electrical performance.

ELECTRICAL TYPES OF WAGNER POLYPHASE MOTORS

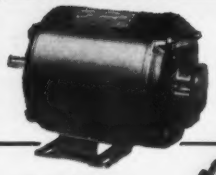
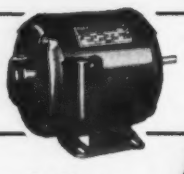
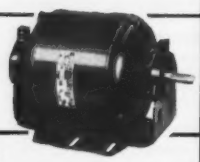
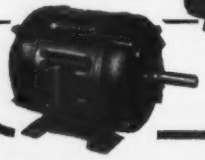
TYPE	RATINGS	CHARACTERISTICS	APPLICATIONS
RP-1	¼ to 400 hp 3- or 2-phase 25 to 60 cycles 110 to 2300 volts	Normal Torque — Normal Slip. Approx. Full-load Slip 3% to 5%.	Group or individual drives on machine tools, fans and blowers, compressors, centrifugal pumps — on any application where normal-torque motors are satisfactory.
RP-5	1½ to 200 hp 3- or 2-phase 60 cycles 110 to 2300 volts	High Torque — Normal Slip. Approx. Full-load Slip 3% to 5%.	Crushers, plunger pumps, belt conveyors starting under load, large air compressors, large refrigerating machinery, mixers, and other applications requiring high starting-torque.
RP-6	½ to 150 hp 3- or 2-phase 25 to 60 cycles 110 to 2300 volts	High Torque—High Slip. Approx. Full-load Slip 5% to 8% or 8% to 13%.	Punch presses, shears, metal-drawing operations, balers and other machinery equipped with flywheels or having flywheel effect.
RP-7	1 to 60 hp 3- or 2-phase 25 to 60 cycles 110 to 550 volts	High Torque—High Slip. Approx. Full-load Slip 15% to 17%.	Elevators, cranes, hoists, dumbwaiters.
RS-1	1 to 250 hp 3- and 2-phase 25 to 60 cycles 110 to 550 volts	Continuous Duty — constant and adjustable varying speed.	Conveyors, compressors, pulverizers, etc., requiring continuous operation.
RS-2	2 to 200 hp 25 to 60 cycles 208 to 550 volts	Intermittent Service — Crane and hoist duty.	Elevator, crane, hoist, and like services requiring but short periods of motor operation.

The electrical types listed at the left and the multi-speed motors listed at the extreme right may be varied with the types of enclosures listed at the right.

DIRECT-CURRENT MOTORS

Direct-Current motors are built as a companion line to the alternating current motors to enable machinery manufacturers to supply Wagner motors on all units, including those destined for areas served with direct current. 1/20 to 3 hp., sleeve or ball bearing, rigid or resilient mounted, 32, 115, or 230 volts.

SINGLE-PHASE

MOTOR DESIGN	TYPE	RATINGS	MECH. VARIATIONS
 Repulsion-Start-Induction	RA	⅛ to 15 hp single-phase all commercial voltages and frequencies	Horizontal or vertical. Dripproof, or totally-enclosed endplates. Rigid, resilient, or flange mountings.
Capacitor-Start-Induction-Run High Torque 	RK	⅛ to ¾ hp single-phase 50-60 cycles 115 to 230 volts	Dripproof or totally-enclosed endplates. Rigid, resilient, or flange mountings.
 Split-Phase	RB	1/20 to ⅓ hp single-phase 50-60 cycles 115 or 230 volts	Dripproof or totally-enclosed endplates. Rigid, resilient, or flange mountings.
Fan Motors Shaded Pole 	TM	1/125 to 1/30 hp single-phase 50-60 cycles 115 or 230 volts	Totally-enclosed. Round frame, rigid or resilient mounting, 3-speed reactor controller available if desired.
 Repulsion-Induction Motors	RG	1 to 5 hp single-phase all standard cycles and voltages	Open and dripproof. Rigid mounting.

Wagner Electric Corporation
EST 1891

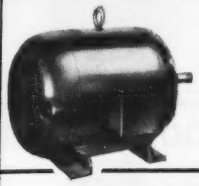
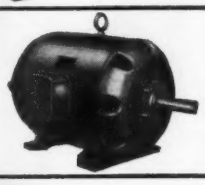
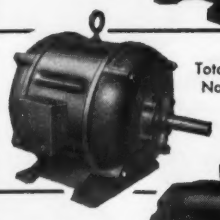
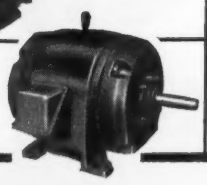
ELECTRIC MOTORS • TRANSFORM
INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE PRODU

M49-22

A COMPLETE LINE...

MOTORS

MECHANICAL TYPES OF PROTECTED AND ENCLOSED SQUIRREL-CAGE MOTORS

TYPE	DESCRIPTION	SIZES
CP	 Standard Totally-Enclosed Fan-Cooled	1½ to 200 hp 2- or 3-phase 25 to 60 cycles 110 to 2300 volts
HP	Explosion-Proof Totally-Enclosed Fan-Cooled 	1½ to 200 hp 2- or 3-phase 25 to 60 cycles 110 to 2300 volts
TP	 Totally-Enclosed Nonventilated	¼ to 15 hp 2- or 3-phase 25 to 60 cycles 110 to 550 volts
XP	Splashproof 	¾ to 125 hp 2- or 3-phase 25 to 60 cycles 110 to 550 volts

MULTISPEED MOTORS

Multispeed squirrel-cage motors are used where more than one running speed is required, but where close speed regulation is not necessary. They are the same basic design and are available with the same electrical characteristics and types of enclosures as single-speed squirrel-cage motors.

CHARACTERISTICS	SPEEDS	APPLICATIONS
Constant Torque motors have the same torque rating at each speed that the horsepower varies directly as the speed.	2, 3, or 4	Typical applications: lathes, boring mills and other machine tools.
Variable Torque motors have torque ratings which are directly proportional to the speeds and consequently the horsepower varies as the square of the speed.	2, 3, or 4	Typical applications: fans, blowers, centrifugal pumps and similar applications.
Constant Horsepower motors have the same horsepower rating at each speed and the torque varies inversely with the speed.	2, 3, or 4	Typical applications: conveyors, printing presses.

MOTORS

APPLICATIONS

Repulsion-Start Motors — the preferred single-phase motors for every type of application, because of their high starting-torque and low starting-current.

Capacitor-Start Motors — for applications requiring high starting-torque, but whose starting periods are not of long duration.

Split-Phase Motors — for applications requiring low-starting torque, such as unit heaters, oil burners, etc.

Shaded Pole Motors — satisfactory only for applications requiring very small horsepower and very low starting-torque, such as fans directly mounted on the motor shafts.

Repulsion-Induction Motors — intended primarily for the more unusual applications involving a very long starting period and a high starting-torque — such as air compressors starting at very low temperatures.

DRY TYPE TRANSFORMERS

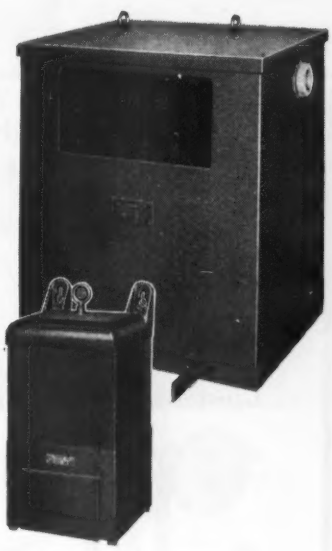
Wagner dry-type transformers are compact and light in weight, easy to install in any location, and easy to move when changes are necessary.

General purpose dry-type transformers are available in ratings from ¼ to 200 Kva, 600 volts and below, single-phase, two coil, type AE and from 3 to 300 Kva, 600 volts and below, three-phase, two coil, Type AP. Type AA autotransformers are also available.

RATINGS 10 KVA AND SMALLER, Type AE, are constructed with endplates clamped over core and coils by through bolts and are designed for wall mounting. These ratings are suitable for indoor or outdoor installation. Listed ratings in this range all bear Underwriters' Approval.

RATINGS 15 KVA AND LARGER, Type AE, are enclosed in ventilated sheet steel cases. These ratings are suitable for indoor installation only. They are normally floor or platform mounted.

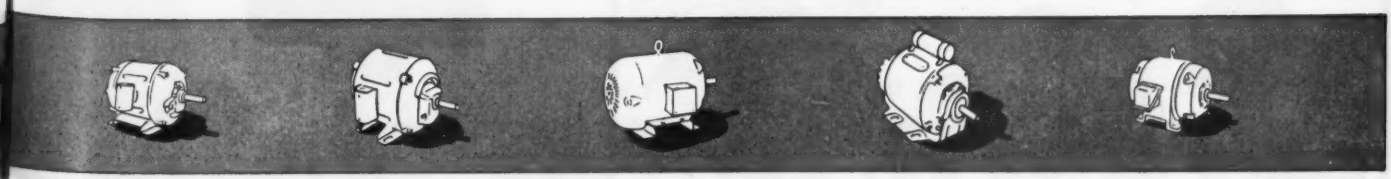
Wagner also builds three-phase dry-type load-center transformers for plant power distribution circuits, in ratings up to 2000 Kva in the 15 Kv class and below.



Bulletins on Wagner Motors, Distribution and Power Transformers will be sent upon request.

Wagner Electric Corporation

6413 PLYMOUTH AVE. • ST. LOUIS 14, MO., U. S. A.



KILLARK ELECTRIC MANUFACTURING CO.

CONDUIT FITTINGS

Established 1913 — *Main Office and Factory:* VANDEVENTER & EASTON AVES. ST. LOUIS 13, MO.

THE CONTENTS OF THIS PACKAGE BEAR THE UL LABEL OF Underwriters' Laboratories

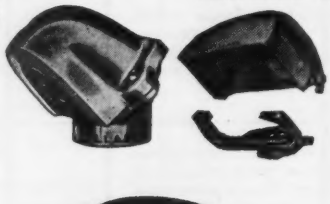
Branch Offices:

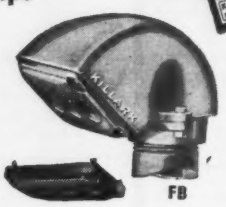
1903 Griffin St. Dallas 2, Texas
Public Ledger Bldg. Rm. 1237 Independence Sq. Philadelphia, Pa.
49 Central Ave. Cincinnati 2, O.
156 Purchase St. Boston 10, Mass.
634 Selden Avenue Detroit 1, Michigan
1900 Euclid Ave. Cleveland 15, O.
564 West Adams St. Chicago 6, Ill.
69 Mills St., N. W. Atlanta 3, Georgia
216 Burnet Ave. Syracuse, N. Y.
401 Marine Nat. Bank Bldg. Baltimore 2, Md.
1123 Harrison Street San Francisco 3, Calif.
4130 First Avenue So. Seattle 4, Washington
924 Andrus Building Minneapolis 1, Minn.
4501 Maryland Ave. St. Louis 8, Mo.
412 Seaton Street Los Angeles, Calif.
614 West 26th Street Kansas City 8, Missouri
30 Irving Place New York 3, N. Y.
2134 Curtis Street Denver, Colorado
298 Duquesne Way Pittsburgh 22, Penna.

SERVICE ENTRANCE FITTINGS

Entrance Caps


FB

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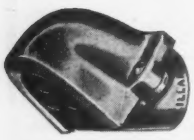
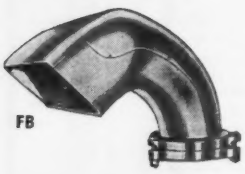
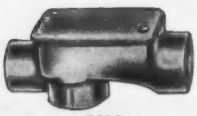



FB

Entrance Elbows


NSLB

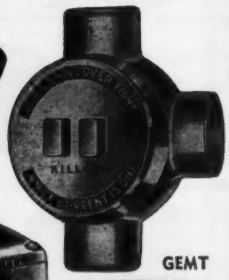

SLB


GSLB

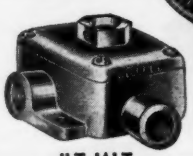
EXPLOSION-PROOF FITTINGS


XPB

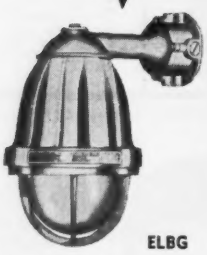

EY


GEMT

Explosion Proof Junction Boxes →


JLT-JALT

Explosion Proof Lights ↓

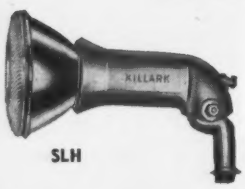

ELBG


ELG


ELXG

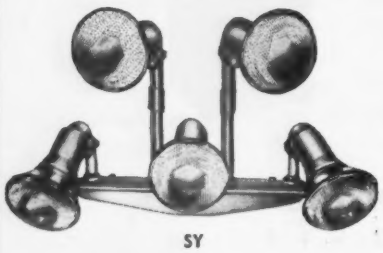
KILLARK VERSATILE SEALED BEAM LIGHTING EQUIPMENT

Rustless Aluminum—Weatherproof


SLH


SLHM

Cluster-Life Fixtures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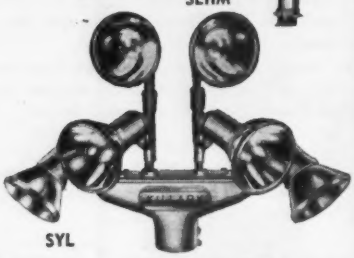
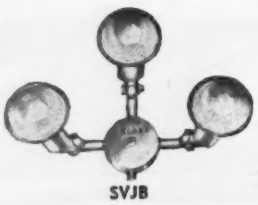

SYL


SVJH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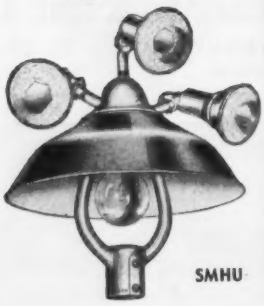
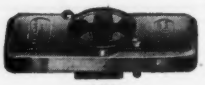

SMHU

CONDUIT BODIES AND COVERS

Series "L" Electrolets


NTB YTB

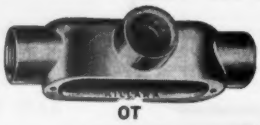

APR


TYPE L


TB


Blank Metal Cover

Series "O" Electrolets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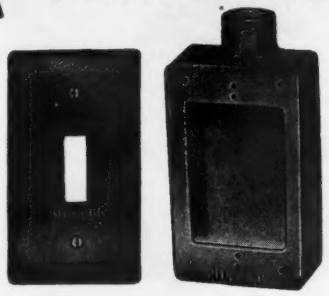
NOT YOT

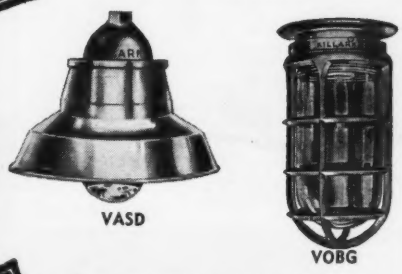

OPR

FLUSH SWITCH FITTINGS



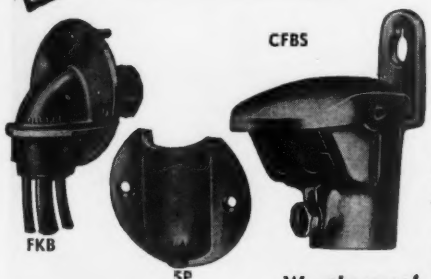
FSST FS

VAPOR-TIGHT LIGHT FIXTURES



VASD VOBG

FITTINGS FOR RURAL ELECTRIFICATION

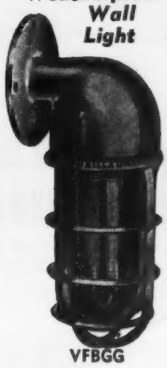


CFBS FKB 5P

Weatherproof Receptacle

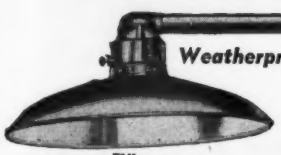
FSWRC

Weatherproof Wall Light



VFBGG

Weatherproof Yard Light

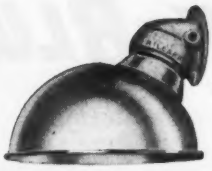


FYL

Lighting Fixtures

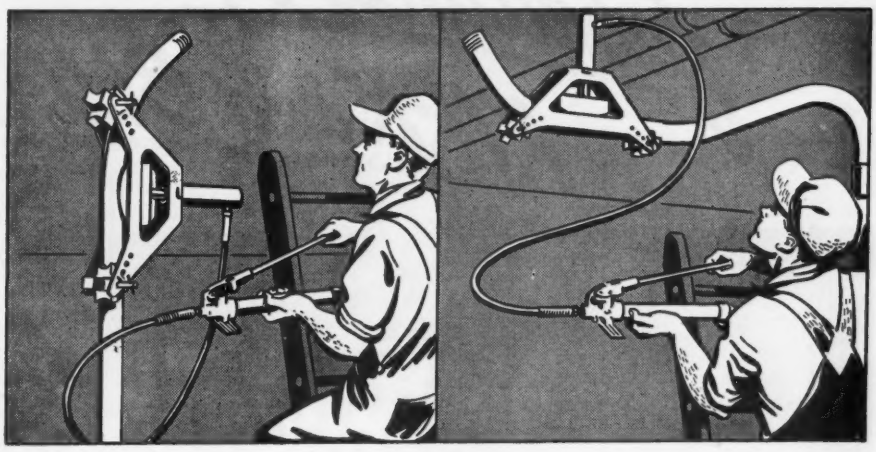
VFCA

Conch-Light



RYLD-ISR

You Get 4 Exclusive Advantages with a Blackhawk Pipe Bender



1. WORKS IN ANY POSITION

A Blackhawk Porto-Power Pipe Bender is completely versatile. It works in any position — vertical — horizontal — or at any angle. The remote control Porto-Power pump makes this extra utility possible.

3. TAKE IT RIGHT TO THE JOB

A Blackhawk pipe bender's light weight and all-directional operation lets you bend pipe right at the installation instead of lugging pipe to the bender. Saves time — work — steps — makes it easier to fit bends to obstructions.

2. DO OTHER WORK

The Blackhawk Porto-Power hydraulic unit detaches to work with numerous other Porto-Power attachments to handle dozens of lifting, pulling, pushing, clamping, pressing, bending and spreading operations.

4. ELECTRIC OPERATION IF DESIRED

P-182 electric pump permits *finger-tip control* pipe bending — speeds work —leaves hands free for measuring. Ideal for continuous bending of elbows, etc. P-182 also can convert any other hydraulic equipment to power operation.

S30A Pipe Bender with 10-ton hydraulic unit handles rigid conduit and pipe in 1, 1¼, 1½ and 2" diameters.

S36 Pipe Bender with 20-ton hydraulic unit handles rigid conduit and pipe from 1¼ to 4" in diameter.

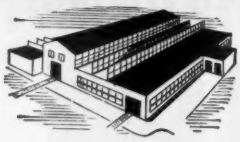
Your Blackhawk Industrial Supply Distributor will give you full information on cost-cutting Blackhawk Porto-Power Pipe Benders.

A Product of **BLACKHAWK MFG. CO., Dept. P-2079, Milwaukee 1, Wis.**

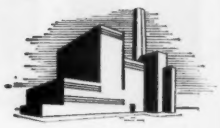
BLACKHAWK®

HANDJACKS • WHEELED JACKS • WRENCHES • PORTO-POWER • RECK-RACK

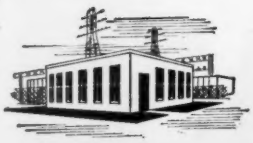
Control enclosures and panels *fabricated by KIRK and BLUM*



For Industry



Power Plants



and Utilities

Whatever your requirements in control panels or electrical enclosures, KIRK & BLUM is equipped to fabricate them to your most exacting specifications. Whether it's a board with one or two instruments . . . or almost a hundred (as illustrated above) KIRK & BLUM has the experience and facilities to do a first-class job.

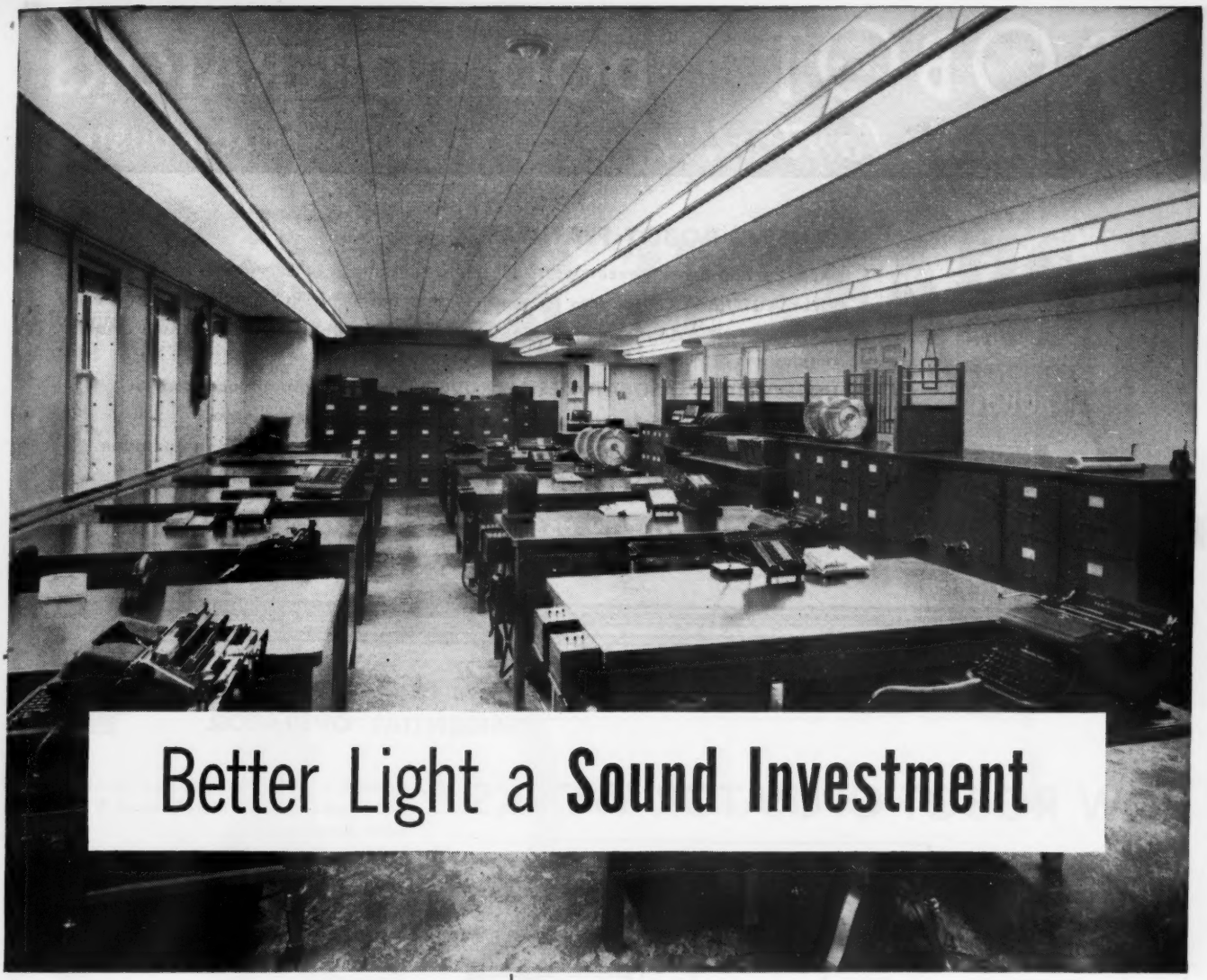
The control panels above, constructed for an electrical machinery manufacturer, are 20′ and 28′ long, 8′—6″ high and 4′—8″ deep. The body of the panel is constructed of ¼″ steel plate, the light canopy above of ⅛″ steel.

KIRK & BLUM will gladly quote on your requirements . . . one or a thousand units . . . any size. Send prints and specifications to The Kirk & Blum Manufacturing Co., 2903 Spring Grove Ave., Cincinnati 25, Ohio.

A free booklet, "Sheet Metal Assemblies" lists Kirk & Blum facilities for fabricating metals up to ⅜". Write for your copy.

KIRK AND BLUM

CONTROL DESKS and PANELS • SWITCH GEAR HOUSINGS • CUBICLES • TRANSFORMER HOUSINGS and TANKS • ELECTRICAL ENCLOSURES MACHINE BASES • VENTILATING LOUVRES



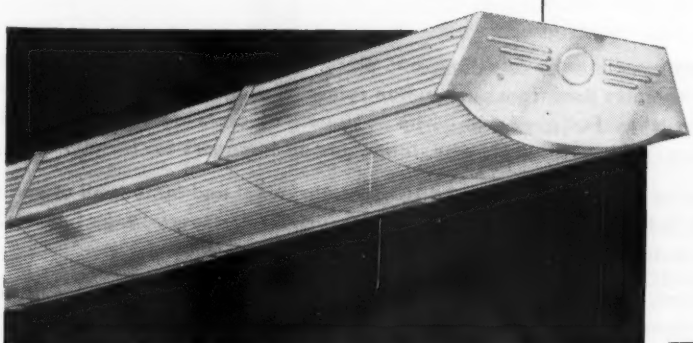
Better Light a **Sound Investment**

...for New Hampshire Finance Corp.
Manchester, New Hampshire

Lighting Engineer: W. W. Burke, Public Service Company of N. H., Manchester, N. H. • Electrical Contractor: A. L. Franks Co., Manchester, N. H. • Lighting Equipment: Litecontrol No. 9224, 2-lamp surface lens fixture • Lamps: 40 watt, 3500 degree white, fluorescent • Total Wattage: 3,300 • Watts per Square Foot: 2.8 • Footcandles: 45 average maintained.

Working with figures is a pleasure in this modern office recently relighted with Litecontrol fixtures. Eyestrain . . . in checking records, in making entries, in filing . . . has been eliminated and each worker's efficiency materially increased.

Though not efficiency experts, Litecontrol engineers are experts in planning better lighting that *always results in better efficiency* in offices, schoolrooms, stores and factories. And they'll be glad to help you with new and unusual lighting ideas or with complete lighting layouts.



...with LITECONTROL FIXTURE NO. 9224

Ideal for offices is this surface type fixture with intensive, well distributed downlight controlled by the prismatic action of Holophane Controlescent lenses. Luminous slanting side panels give good ceiling illumination and reduced contrast. Special baked, white plastic-type finish will not crack, peel or discolor.

Cat. No.	Lamps	Length	Width	Height
9224	2-40W	48⅛″	15″	6¾″
9234	3-40W	48⅛″	15″	6¾″

9200-3 End cap for individual units or continuous runs

LITECONTROL *Fixtures*

LITECONTROL CORPORATION
36 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

KEEP UPKEEP DOWN

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

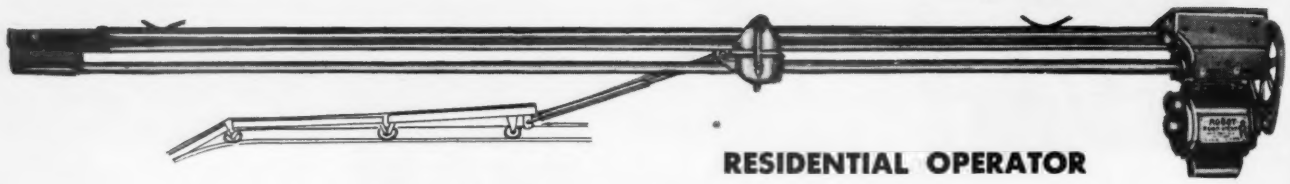
ROBOT DOOR OPERATORS

Electronically Controlled RESIDENTIAL · COMMERCIAL · INDUSTRIAL

EXCLUSIVE ROBOT FEATURES . . .

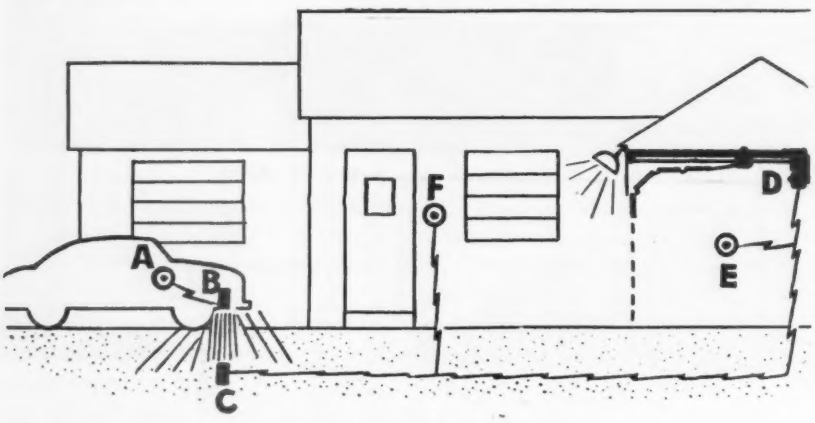
1. **SAFE:** Friction drive prevents personal injury or damage to garage door.
2. **FULLY AUTOMATIC:** Operates from magic push buttons in car, garage and house.
3. **REMOTE CONTROLS:** Positive and foolproof in any weather. Guaranteed not to violate regulations of Federal Communications Commission.
4. **UNDERWRITERS LABORATORIES APPROVED.** Complies with all local codes.
5. **DEPENDABLE:** Rugged, practical and quiet. Guaranteed for one year.
6. **ECONOMICAL:** Lowest priced automatic operator in initial cost and in operation.
7. **OPERATES ALL TYPES** of single and double garage doors electronically.

MANY THOUSANDS IN USE . . . SOME FOR OVER 18 YEARS



RESIDENTIAL OPERATOR

HOW ROBOT OPERATOR WORKS



A. CONTROL BUTTON connected to electrical system of your car. Merely touch it as you enter driveway.

B. ELECTRIC COIL underneath your car radiates magnetism to mercury switch buried underneath driveway.

C. MAGNETIC SWITCH (2" square) then closes 12-volt circuit which controls ROBOT Door Operator in garage.

D. ROBOT DOOR OPERATOR electronically unlocks and opens any type of garage door. . . also switches on garage and yard lights automatically.

E. & F. CONTROL BUTTONS in both garage and house close and lock garage door and switch off the lights.

WHEN LEAVING, PROCEDURE REVERSES

RESIDENTIAL OPERATOR SPEC'S — For all single or double doors: sectional overacting, one-piece overacting, tilt, and two-piece outward swing. Unlocks and operates door from push button controls inside car, garage and home . . . or from convenient key switches. Equipped with ¼ hp., 110 volt, 60 cycle motor with thermal protection; terminals for garage and yard lights; wire, lubricants and hangers for installation.

COMMERCIAL OPERATOR SPEC'S — For all types of light commercial doors requiring up to 10′ operator travel and 50 lb. pull at point of attachment. Equipped with ⅓ hp. capacitor start, 110 volt, 60 cycle motor; low voltage 1-button, 2-button, key-switch or car control; wire and hangers for installation.

INDUSTRIAL OPERATOR SPEC'S — Four sizes . . . for all sectional, one-piece, sliding, folding and industrial doors requiring up to 350 lbs. pull at point of attachment. Equipped with ½ hp. motor for 110-220 volt single-phase or 220-440 polyphase, reversing contactor, limit switches and 3-button control. Optional controls: photo-electric, drive-over and foot pedal.

NATION-WIDE SALES, INSTALLATION & SERVICE . . . WRITE FOR COMPLETE CATALOG

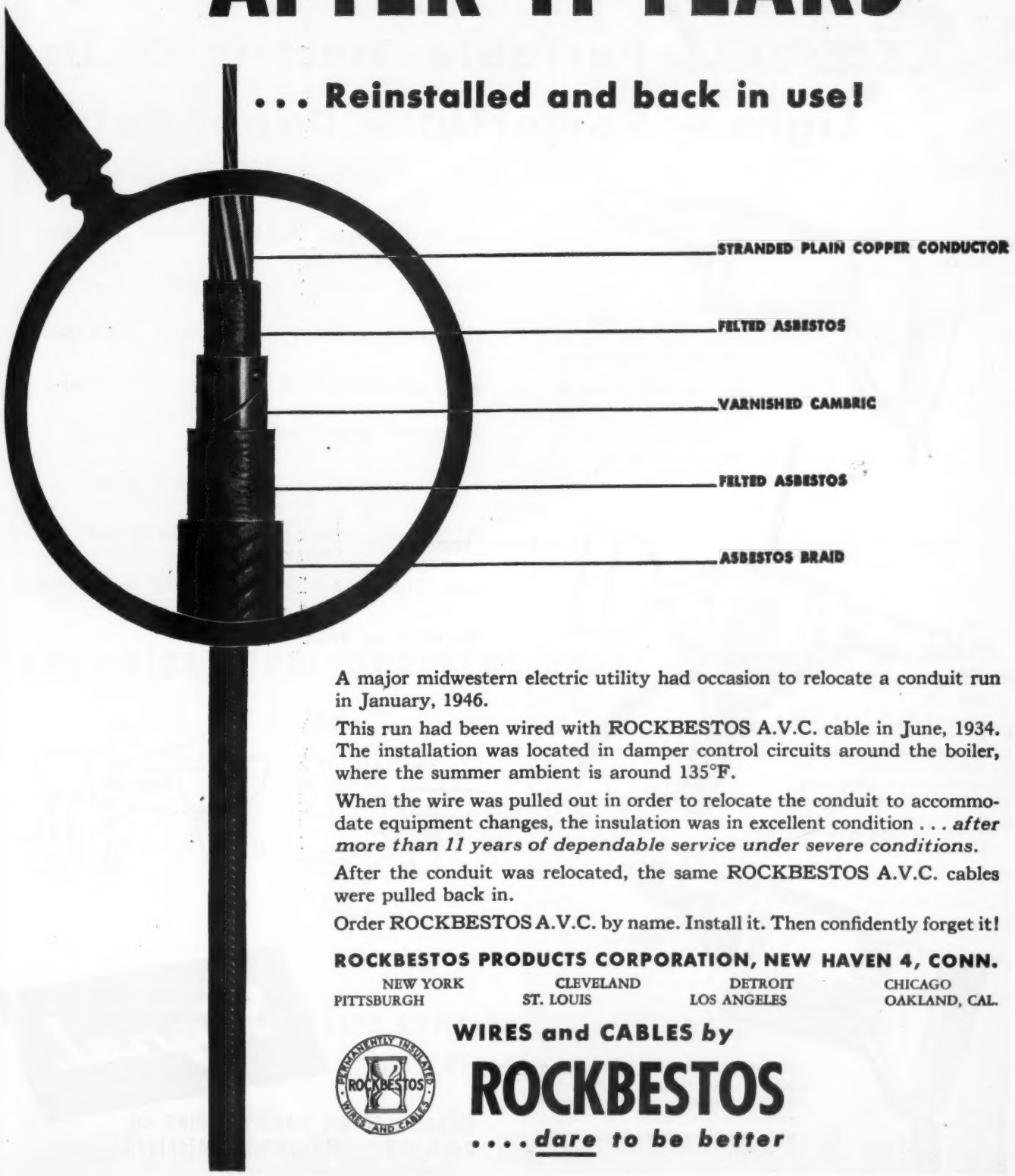
ROBOT APPLIANCES, INC.

13165 Prospect Ave. · Dearborn, Mich.

Cable pulled from conduit

AFTER 11 YEARS

. . . Reinstalled and back in use!



A major midwestern electric utility had occasion to relocate a conduit run in January, 1946.

This run had been wired with ROCKBESTOS A.V.C. cable in June, 1934. The installation was located in damper control circuits around the boiler, where the summer ambient is around 135°F.

When the wire was pulled out in order to relocate the conduit to accommodate equipment changes, the insulation was in excellent condition . . . *after more than 11 years of dependable service under severe conditions.*

After the conduit was relocated, the same ROCKBESTOS A.V.C. cables were pulled back in.

Order ROCKBESTOS A.V.C. by name. Install it. Then confidently forget it!

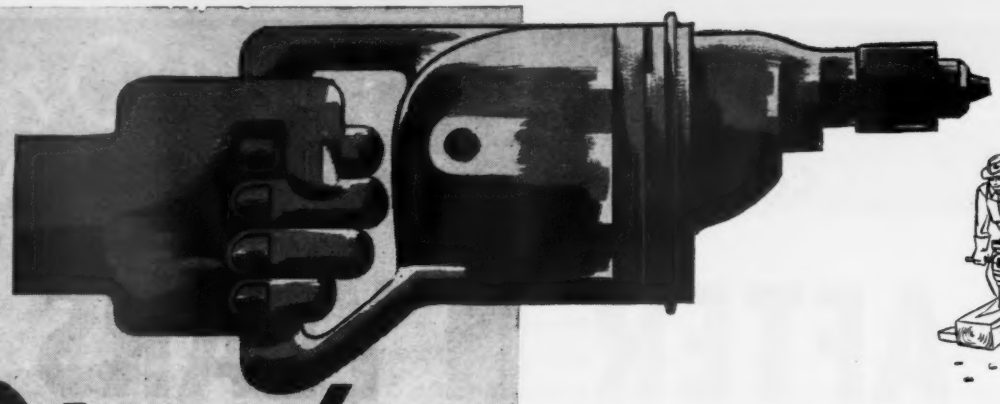
ROCKBESTOS PRODUCTS CORPORATION, NEW HAVEN 4, CONN.

NEW YORK CLEVELAND DETROIT CHICAGO
PITTSBURGH ST. LOUIS LOS ANGELES OAKLAND, CAL.

WIRES and CABLES *by*

ROCKBESTOS

. . . . dare to be better



Signal Portable Electric Drills . . . Light — Powerful — Dependable

OB-8 Drill
Type OB-8 — 3000 RPM, ¼" Light Duty, High-Speed Drill — Designed for intermittent service, the OB-8 is ideal for radio repair work, wood and metal assembly, and boat building. This unit equipped with Jacobs key-type chuck and bronze, oilless-type bearings.

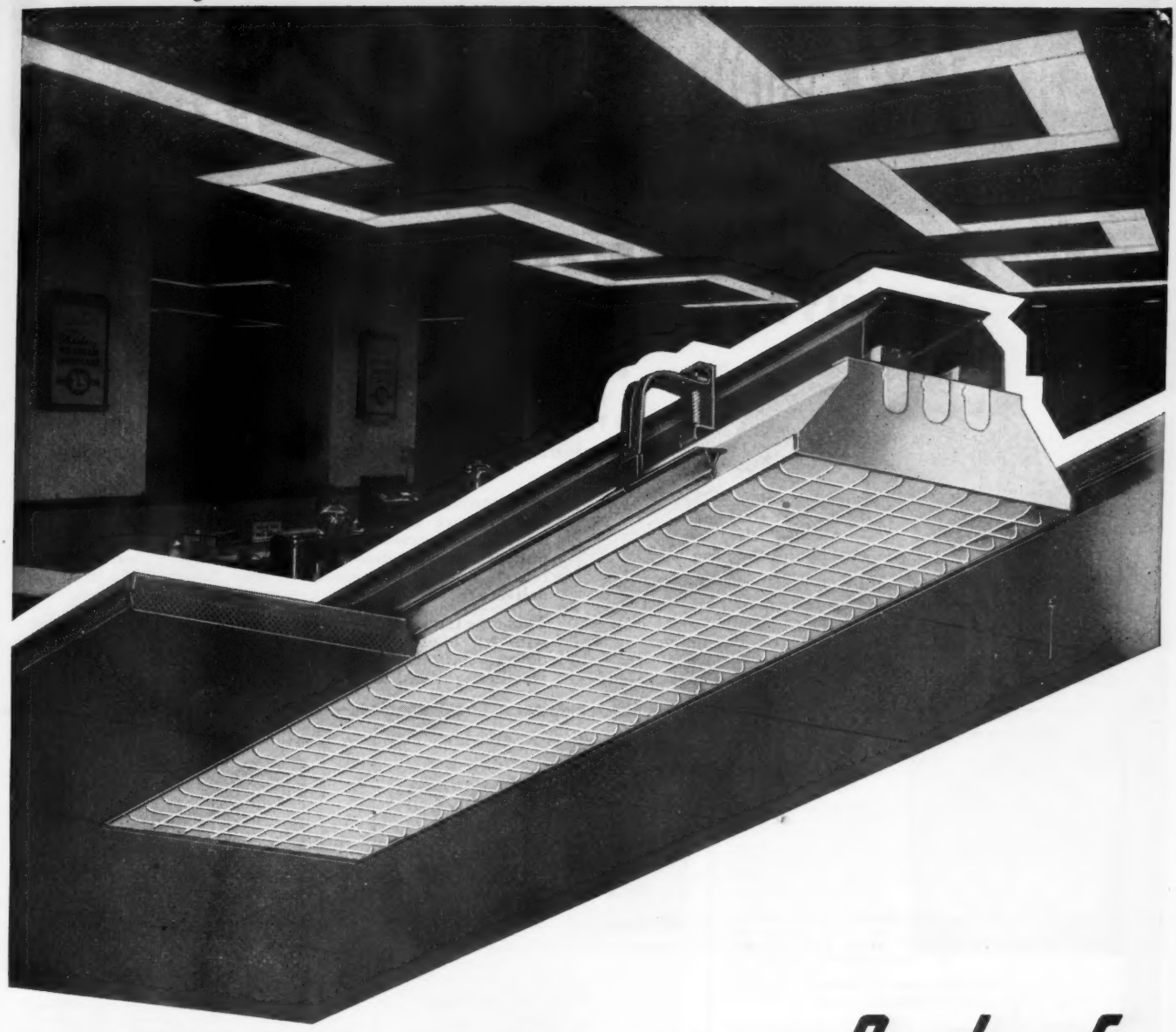
OB-5 Drill
Type OB-5 — 400 RPM, ½" Standard Duty Drill — This powerful, sturdy unit is light and easy to handle . . . highly recommended for general production, machine shop and maintenance work . . . ⅝" Jacobs key-type chuck also available.

OB-4 Drill
Type OB-4 — 1700 RPM, ¼" Standard Duty Drill — Built for long, tough service, the OB-4 is especially suited for general maintenance, construction and building work . . . can be supplied with the Jacobs key-type ⅜" chuck.

Job-tested Signal Portable Electric Drills are designed to do your job better . . . more efficiently . . . more economically. Yes, *Signal* gives you everything you want in a drill — air-cooled, grip-fitted handle . . . light weight . . . correct balance . . . dependable power . . . PLUS many years of trouble-free service. Ask your *Signal* Distributor for new descriptive literature on drills.

Signal

SIGNAL ELECTRIC MANUFACTURING CO.
Dept. C-4 Menominee, Michigan



SPECIFICATIONS: TROFFERS SHALL BE *Smithcraft*

~~**OR EQUAL**~~

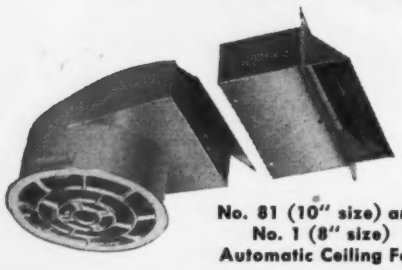
there is no equal!

**THERE'S A BOOKLET ENTITLED "ARCHITECTURAL TROFFERS"
THAT TELLS YOU WHY**

write..... ***Smithcraft*** **LIGHTING DIVISION, CHELSEA 50, MASS.**

SHEPLER RADIA ELECTRIC HEATERS and VENTILATING FANS

Introducing—A COMPLETELY NEW, IMPROVED 8" AUTOMATIC FAN FOR SMALL ROOMS



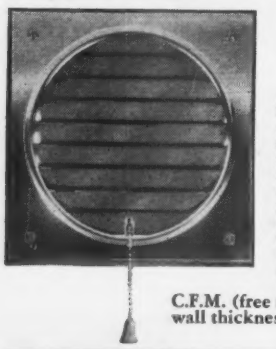
No. 81 (10" size) and
No. 1 (8" size)
Automatic Ceiling Fan

- **Designed specifically for bathrooms, kitchenettes, powder rooms, etc.!**
- **For either ceiling, wall or cabinet installation!**
- **Lowest price fan of this type on the market today!**

This completely new, 8" automatic ventilating exhaust fan, the No. 1, is especially constructed for quick, easy installation in small rooms where wall space is limited or unavailable. It fits all standard construction and may be mounted horizontally or vertically for installation in duct, air shaft or its own outside wall unit. The powerful, totally enclosed, self-aligning fan motor and patented 8" Torrington propeller assure years of quiet, trouble-free operation. The motor-blade assembly plugs in and is attached to the polished die-cast aluminum grille to simplify cleaning. The No. 1 model has a rating of over 500 C.F.M. (free air delivery).

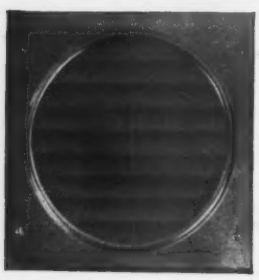
This type fan is also available in the standard No. 81 model with 10" blades and has a rating of 650 C.F.M. (free air delivery). Both sizes feature double automatic shutters and weathertight seal to prevent back drafts and sweating.

Approved by Underwriters' Laboratories



SHEPLER WALL FAN

A 10" deluxe fan featuring automatic bead chain control and the attractive Invisi-Grille front. Equipped with Redmond 1/70 H.P. motor, it is available in No. 10-C chromium (illustrated), or No. 10 white grille. Wall opening required: 11¼" x 11¼". Rating: 650 C.F.M. (free air delivery). For any wall thickness.



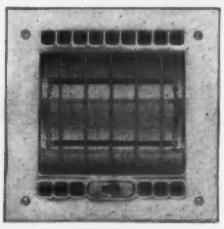
NO. 9 AUTOMATIC WALL FAN

This deluxe 10" fan, with chrome Invisi-Grille, features completely automatic operation and is adjustable for any wall thickness. In addition to the regular fan motor, a worm gear motor operates the insulated and weather-stripped outside door. Both motors are remotely controlled by Shepler Model "S" or regular wall switch positioned for user's convenience. Rating: 650 C.F.M. (free air delivery).

SHEPLER SWITCH and SPEED CONTROL

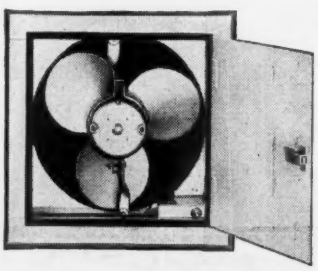
The Model "S" makes it possible to remotely operate and control any fan. It has an "off" position and permits fan speed regulation to "low", "medium" and "high".

No. 1100 Wall Heater



RADIA ELECTRIC WALL INSERT HEATERS

Equipped with the efficient Globar Heating Element, these heaters provide safe, clean, auxiliary heat for as low as 1¢ per hour. Available in sizes and capacities up to 3000 watts to suit every requirement; finish is either chrome, or white or colored porcelain enamel.



DOOR OPERATED FAN

This adjustable 10" fan is of rugged steel construction, finished in white Durenamel. Built-in switch controlled by opening and closing of door. Available in two models—No. 4-A adjustable sleeve and No. 4 with separate outer louver. Rating 650 C.F.M. (free air delivery).

DUCT, FLUE, CHIMNEY FANS

These fans may be installed in cabinets, ducts or flues or vented into unused space above ceiling. Available in both 8" and 10" sizes and two models—with or without shutters. Automatic operation by wall switch. Polished aluminum grille. Rating: 650 C.F.M. (free air delivery).

EVERYBODY PROFITS WITH SHEPLER "PREFERRED" PRODUCTS

• Radia Electric Wall and Portable Heaters • 8" and 10" Wall, Ceiling, Chimney and Automatic Fans • Automatic Wall and Ceiling Shutters • Fireplace Logs—Electric (with or without heat) and Gas-Electric Combination • Medicine Cabinets

Write Dept. E-5 for complete details.

SHEPLER *Manufacturing Company*

1312-14 SHEFFIELD STREET • PITTSBURGH 12, PA.

Thread 2" pipe in 22 seconds with TOLEDO POWER PIPE MACHINES!

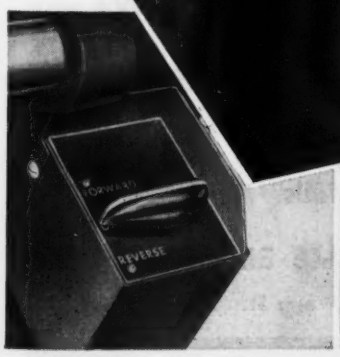
● *You can save up to 80% on pipe threading time*—by using a portable TOLEDO No. 999 Power Pipe Machine instead of hand methods! This saves labor... reduces costs!

The Super Model threads 2" pipe in 22 seconds... or 30 seconds with Standard Model. Cuts off 2" pipe in 10 seconds. Combines speed, production, strength, compactness, portability, dependability and low cost! Ask your distributor for complete details and price. Write for new catalog. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.

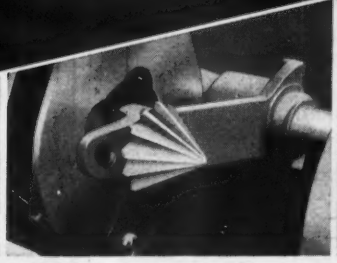
RELY ON THE LEADER

TOLEDO

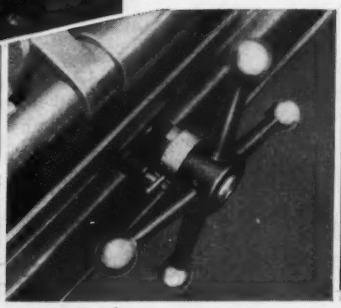
FOR PRECISION PIPE TOOLS



CONTROLS... entirely within forward and reversing switch. Speed adjusted automatically.



REAMING... with 12 tooth cone type fluted reamer mounted on arm on cutter head.

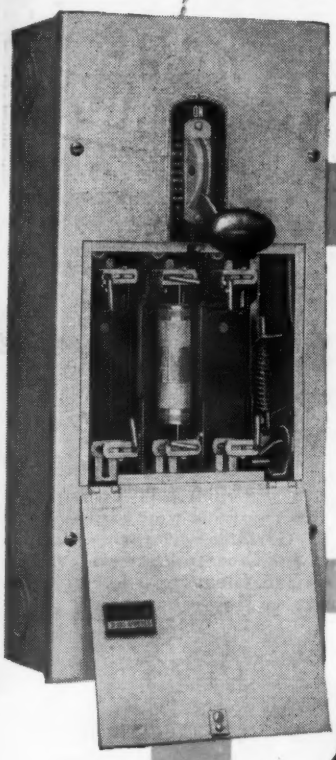


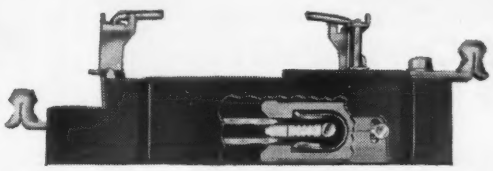
THREADING... speedy, accurate. Thread gauge shows length of thread being cut.

CUTTING... especially fast with 4 cutting knives. Perfect square end cuts. No burred edges.

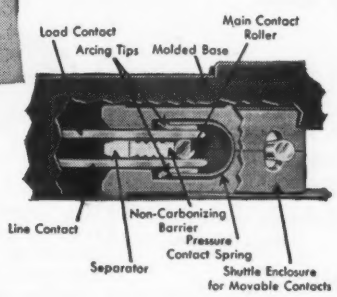
A Time-Tested Switch that's...

Still the Pioneer of BETTER, SAFER SWITCHING!

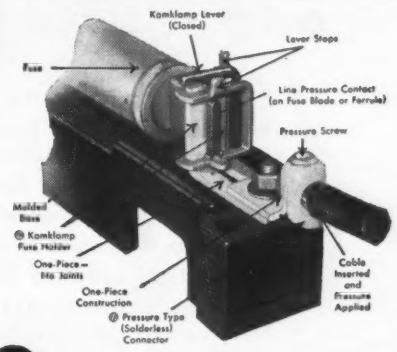




1 **BASES**—Ⓕⓐ Shutlbrak Switch bases are of cold molded material. These bases house the shuttle mechanism and have excellent properties for insulation and mechanical strength.



2 **SHUTTLE DETAILS**—The enclosed shuttle contains the U-shaped spring which keeps the auxiliary contacts and main contact roller under pressure in "on" position. The main contact roller is a heavily electro silver-plated round copper rod which presents a new contact surface at each operation.



3 **KAMKLAMP FUSEHOLDER** — For both ferrule and knife blade type fuse terminals, the Ⓕⓐ Kamklamp fuseholder has pressure type contacts to reduce heating, and eliminates the need for auxiliary means of obtaining pressure between fuse terminals and the fuseholder.

SHUTTLE MOVEMENT, the still-new but time-tested feature found only in Ⓕⓐ Shutlbrak Switches, continues to provide safer, sounder switching for industry.

Ⓕⓐ Shutlbrak Switches embody the latest in design and construction . . . with such features as a barrier between the line and load contacts that *resists arcing* at all times . . . quick make and break connections . . . and heavily silver-plated copper contacts which actually improve with use.

It's an ideal switch for motor control, for service entrance, for any industrial job that demands safe and dependable switching. And, of course, it is approved by Underwriters' Laboratories.

Write for Bulletin No. 501 or see your nearest Ⓕⓐ Representative (he's listed in Sweet's).

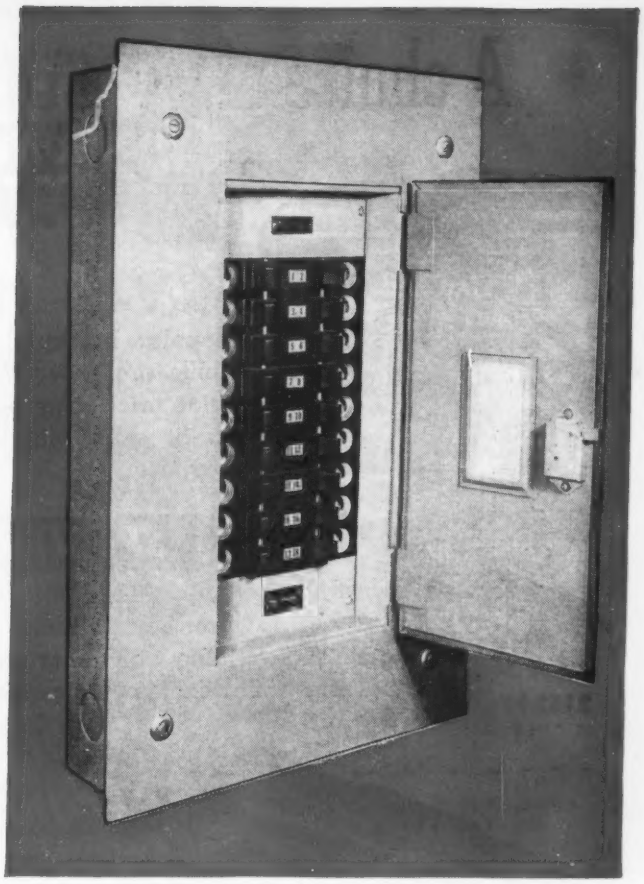
Frank Adam Electric Co.

ST. LOUIS 13, MISSOURI

Makers of BUSDUCT • PANELBOARDS • SWITCHBOARDS • SERVICE EQUIPMENT • SAFETY SWITCHES • LOAD CENTERS • QUIKHETER

Trumbull brings you

two new low-cost lighting panelboards with unique 6-circuit section design



A hot-molded phenolic section containing six complete circuits with features used generally only on higher-priced panelboards is the *news* in two new panelboards for large and small installations introduced on Trumbull's 1949 Train of Electrical Progress.

Ease of installation and maintenance and safe, uninterrupted control are provided by:

UNIQUE 6-CIRCUIT SECTION — All parts firmly attached. No loose straps. Ample room for tamper-proof fuses.

EASY TO INSTALL— Box, panel, and front are unit-packaged. Panelboard fits standard stud walls without projection. All terminals accessible. Spacious wiring gutters. Adequate knock-outs.

EASY OPERATION— Quick-make, quick-break tumbler switches with large operating handles, spring-loaded. Full-floating, positive pressure contacts.

OTHER FEATURES—Silver finish throughout. Circuit lock-off device available.

Fully tested and approved by Underwriters' Laboratories, Inc.

Specify NTPR for group and branch circuit control in industrial and commercial applications; NTPS for stores, garages, residences.

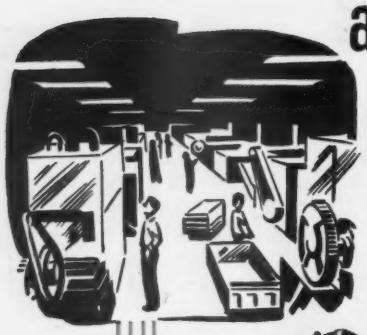
For more information, write for circular TEC 4, THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn.

Men Who Observe the Best Electrical Practice Make It a Practice to Use

TRUMBULL (T) ELECTRIC

TRUMBULL'S TRAINLOAD OF NEW PRODUCTS

A choice of 3 FINE UNITS at MONEY SAVING PRICES!



SILV-A-KING'S

popular Industrial Fluorescent Units are now available in a wide price range — there's one to fit every purse and every purpose.

2152 PT

***SPECIFICATION**

RLM approved with G. E. Turret Lampholders. Width 13½", length 52". Available with either open or closed-end reflector. Lifetime porcelain enamel.

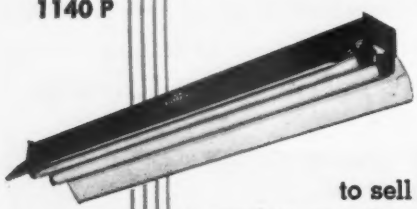
List Price $33.15

1140 P

***ECONOMICAL**

a full size 13½" W x 52" L open-end unit. It offers many of the famous Silv-A-King features found in the "Specification" line.

List Price $22.40



P-402

***THRIFTY**

a brand new unit designed to sell at the very lowest price for a quality unit. Open-end reflector, 11" W x 48" L.

List Price $18.25

***Units illustrated and prices quoted are based on 2—40 W lamp units with a lifetime porcelain-enamel reflector. Also available in synthetic baked enamel at slightly lower prices.**

Now there's no need to lose any business on Industrial Fluorescent installations. The highest quality . . . modern design . . . patented features — all at prices your customers will be glad to pay — are included in the Silv-A-King line. Write for catalog and complete specifications.

BRIGHT LIGHT REFLECTOR CO.

INCORPORATED

Subsidiary of BRIDGEPORT PRESSED STEEL CORPORATION

FAIRFIELD & STATE BRIDGEPORT 5, CONN.

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SILVAKING LIGHTING EQUIPMENT

DOUBLE DEPENDABILITY

is the reason why more and more time switch buyers are specifying

Dependable PRODUCT!
Dependable MANUFACTURER!

Specifications

- 35 ampere, 120 volt switch
- Self-starting, synchronous timing motor
- Manual control
- Automatic reset
- Sturdy terminal block, large terminal screws
- Combination ½" and ¾" knockouts in back, bottom and each side
- Drawn steel case with spring hasp to keep door closed
- Entire mechanism removed by loosening one screw
- Fully guaranteed and Underwriters' Approved

Write for complete details

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$10.95 LIST f.o.b. factory, Chicago

INTER-MATIC TIME SWITCH

NOW IS THE TIME...
to cut job costs

with the new

SIZE 8U ROTARY ELECTRIC IMPACTOOL

Rated capacity 5/8" bolt size

Not eleven tools to do eleven jobs—but eleven tools in *one*—a real multi-purpose tool—an engineering marvel made possible by the amazing power produced by thousands of rotary impacts.

There is no kick or twist even on the toughest jobs—motor burn-outs are eliminated because the motor continues to run smoothly even if you stall the spindle completely—and you will save time and money on all operations—nut running as much as 90%.

An I-R Impactool pays for itself in 30 days with normal use.

Ask your Ingersoll-Rand distributor for a demonstration,

Ingersoll-Rand

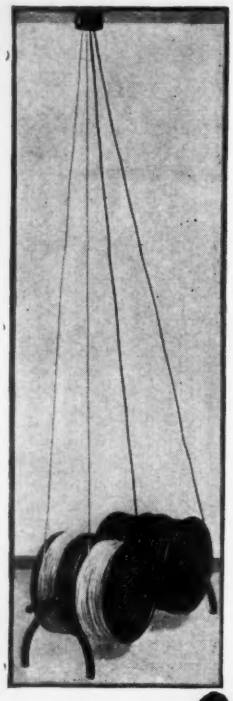
11 Broadway, New York 4, N. Y.

ORIGINATOR OF IMPACTOOLS—air and electric

KIT No. 1—IMPACTOOL, with standard equipment, plus a complete assortment of attachments in a Handy De Luxe Case
110 V or 220 V, AC or DC models available

420-18

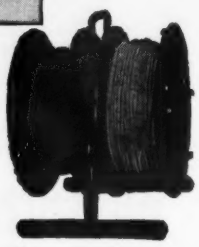
HyKon
LABOR SAVING TOOLS



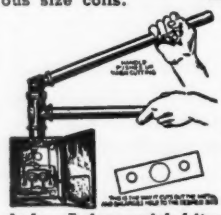
HYKON GANG REELS

Gang reels are indispensable in pulling many wires on the job. Wire is pulled easily, free from kinks and tangles. The reels need no attention as wire can be pulled from top or bottom, or from any angle without upsetting. Reels work independently and all have an adjustable brake. All HyKon Reels are quickly loaded by removing the outer disc and dropping on a full coil of wire. Also available in six units.

HYKON DOUBLE UNIT REEL



The double reels are easily carried about by one man. They are very handy for any wire pulling job. All HyKon Reels are adjustable for various size coils.

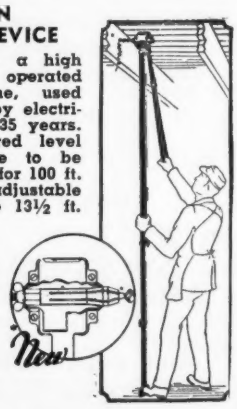


HYKON KNOCKOUT TRIMMER

Starting with at least a half inch knockout, this tool will enlarge the hole to any size or shape by nibbling a bite from the edge of the hole. A few quick bites and the knockout is enlarged exactly as you want it. Can be carried in your tool box. No extra punches are needed.

HYKON BORING DEVICE

The HyKon is a high speed strap operated Boring Machine, used and endorsed by electricians for over 35 years. Holes are bored level permitting wire to be pulled through for 100 ft. Standard is adjustable from 4½ ft. to 13½ ft. Has a self centering chuck for any standard square shank bit. Four pulls on the strap drive the bit through the toughest joist. Fully guaranteed to stand up under the hardest use.

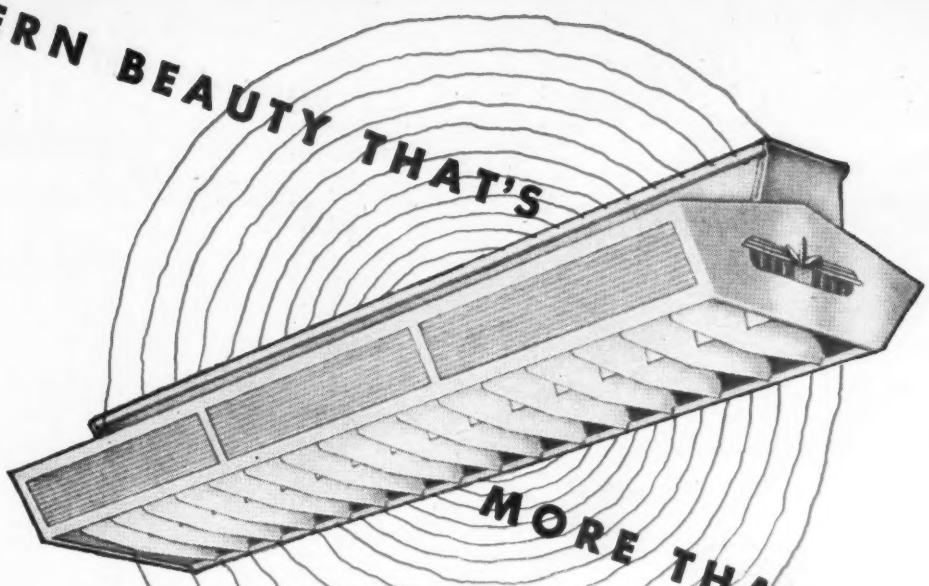


SEND FOR LITERATURE

HYKON MFG. CO.

ALLIANCE, OHIO

MODERN BEAUTY THAT'S



MORE THAN SKIN DEEP

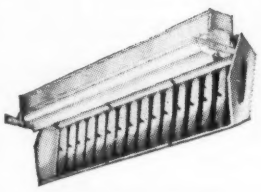
Wheeler commercial turret* line

The extra value available in Wheeler "Skilled Lighting" shows up in the built-in beauty of Commercial Turret Line Fixtures. Next to good lighting comes good looks . . . and the longer they last, the sounder the investment for schools, hospitals, stores, office and public buildings.

Wheeler Commercial Turret Line Fixtures are designed to maintain acceptable low brightnesses at all normal viewing angles. Luminous glass side panels diffuse light in the line of vision.

These fixtures are designed for use with two 40-watt lamps, 3½" spaced, unique demountable turret-type lampholders and detachable pivoted body construction. Lamp sockets slide back and forth on integrally formed channel tracks for easy installation and maintenance . . . then clamp in place. Fixtures are available for either surface-ceiling mounting or pendant stem suspension. Write for complete details.

Wheeler Reflector Company, 275 Congress St., Boston 10, Massachusetts.



Notice how the one-piece louver body swings open . . . from either side. Simplifies servicing.

Handy G. E. Turret* Lampholders provide spring tension that holds lamps securely. Lamps easily installed or removed without danger of breaking sockets.

OTHER SKILLED LIGHTING FIXTURES

There's a Wheeler Incandescent or Fluorescent Fixture to meet every industrial requirement.

Distributed exclusively through electrical wholesalers

Wheeler REFLECTORS

SKILLED LIGHTING

*Reg. U. S. Pat. Off.

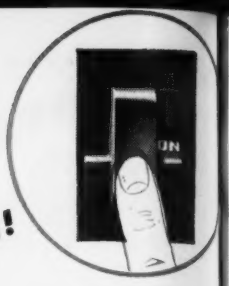
MADE BY SPECIALISTS IN LIGHTING EQUIPMENT SINCE 1881

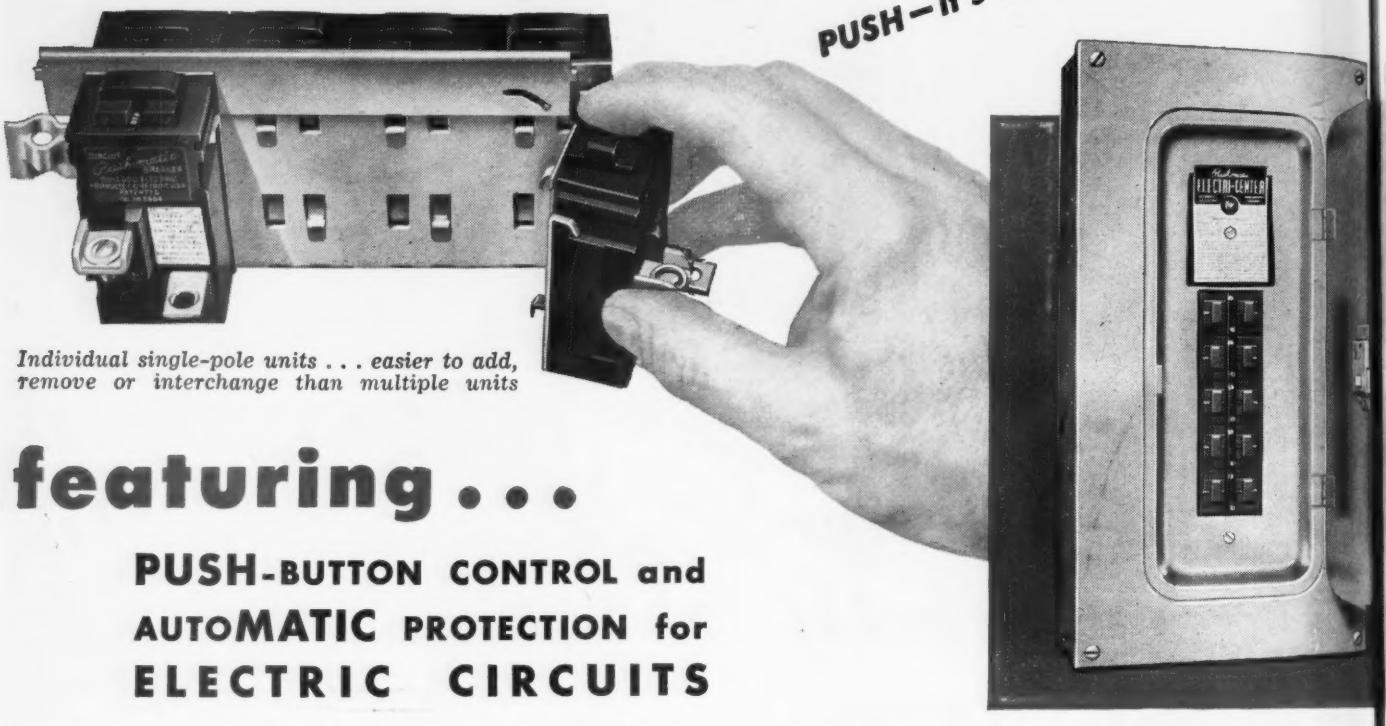
SEE THE NEW *Pushmatic*

PUSH—it's ON!

PUSH—it's OFF!

PUSH—it's ON again!





Individual single-pole units . . . easier to add, remove or interchange than multiple units

featuring . . .

PUSH-BUTTON CONTROL and AUTOMATIC PROTECTION for ELECTRIC CIRCUITS

NOW BULLDOG's revolutionary, new *Pushmatic* gives you *positive* finger-tip control and *automatic protection* against overload and short circuits!

A push of the finger makes or breaks the circuit. There's no resetting manually when the circuit is broken by short or overload. Just PUSH—and service is restored.

Pushmatic is compact, sturdy, simple . . . the most versatile and flexible unit available today. It will meet *every* new or changing load condition.

And *Pushmatics* are easy to install. There are no complicated group mountings . . . individual single-pole units make additions and changes a simple matter.

There are four types of *Pushmatics:* THERMAL ONLY, THERMAL MAGNETIC, or either of these types with AMBIENT COMPENSATING FEATURES. All are identical in size and contour, in ratings of 15, 20, 30, 40 and 50 amperes, 120 V., 1 pole, or 120-240 V., 2 poles, AC. All are interchangeable for rating and type.

Find out about *Pushmatic's* outstanding features before you specify or buy any circuit breaker.

Beautifully styled—Functionally p

BullDog Electri-Center with *Pushmatic*

NEW, BEAUTIFULLY STYLED LINE O PROTECTIVE CONTROL CENTERS

THESE sensational, new ELECTR CENTERS, featuring *Pushma* provide electrical control centers th are the last word in efficiency a protection.

They are attractive, compact, simp . . . easy to wire. There's plenty gutter room even in the smalle cabinets.

With ELECTRI-CENTERS the are no fuses to buy, no complicat operations or installation techniqu to remember. You get versatility a adaptability, ease of installation a operation *never before obtainable any panelboard.*

See the new ELECTRI-CENTE at first opportunity, or send in t coupon today for *Pushmatic* Bulle #493. This descriptive bulletin, libe ally illustrated, contains comple information and prices on BullD ELECTRI-CENTERS and the ne *Pushmatics.*

BULLDOG ELECTRIC PRODUCTS COMPA
Detroit 32, Michigan—Field offices in all principal c
In Canada, BullDog Electric Products of Canada, Ltd., Tor

BULLDOG

HEADQUARTERS FOR ELECTRICAL DISTRIBUTION

BULLDOG ELECTRIC PRODUCTS CO.
Detroit 32, Michigan

Please send me your *Pushmatic* Bulletin #493 giving full information and prices on your *Pushmatic* ELECTRI-CENTERS.

Name_____

Company_____

Street Address_____ Zone_____

City and State_____

✓ Check these NEW Features

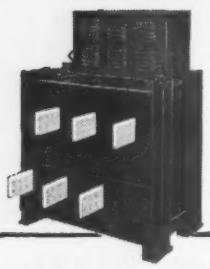
- Positive protection against overloads and short circuits
- Push "ON" and "OFF" for normal manual switching. Push "ON" after automatic tripping—no so-called reset position.
- Trip-free of the handle
- All types and ratings interchangeable, quickly, easily
- Permanent calibration by amperes in one precision-formed part

DON'T BUY UNTIL YOU HAVE SEEN THE LATEST AND FINEST

NEW AIR-COOLED DISTRIBUTION TRANSFORMERS

POLE MOUNTED — OUTDOOR — ALL-PURPOSE — INDOOR — WALL MOUNTED

MARCUS SCORES AGAIN IN THE FIELD OF AIR COOLED TRANSFORMERS



AIR-COOLED TRANSFORMERS
1 to 2,000 KVA up to 15,000 Volts to meet Individual Requirements

- DISTRIBUTION
- GENERAL PURPOSE
- PHASE CHANGING
- ELECTRIC FURNACE
- RECTIFIER
- WELDING
- MOTOR STARTING

From a Pioneer in the field comes a new distribution transformer—AIR COOLED, DRY TYPE. No hazardous oil or toxic liquids to fuss or bother with. The use of superior class B and C heatproof insulation such as fibre-glass, mica, porcelain, new Johns-Manville Quinterra and similar inorganic material results in a transformer that can withstand the overloads that normally would damage an ordinary class A (cotton and paper) insulated oil filled unit. The entire transformer element is seal protected against oil, acids, moisture, etc., and is housed in a sturdy, scientifically ventilated, weatherproof case which conforms with all applicable EEI-NEMA construction standards. This extremely versatile transformer can be used outdoors, pole or platform mounted or indoors at the load center, mounted wherever convenient with no expensive fireproof vault required.

Currently available in sizes to 100 KVA, voltages to 5000 V.

COMPETITIVE PRICES • GOOD DELIVERIES

WRITE FOR BULLETIN #49-ACO

Representatives in Principal Cities

MARCUS TRANSFORMERS CONFORM TO THE STANDARDS OF N.E.M.A. AND A.I.E.E.

MARCUS TRANSFORMER CO.

INC.

34 MONTGOMERY STREET
HILLSIDE 5, NEW JERSEY

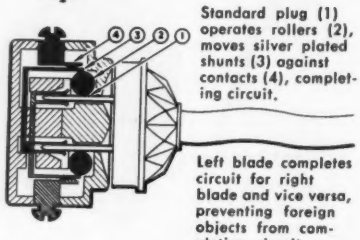
PIONEERS IN THE FIELD OF AIR-COOLED TRANSFORMERS

New SAFETY RECEPTACLE MAKES CONTACT ONLY WHEN STANDARD CAP IS INSERTED

The *SAFETY-PLUS Receptacle

Actual tests prove it to be Safest Receptacle ever designed

- Makes contact *ONLY* when standard cap is inserted
- Conventional operation . . . double contact springs
- Back or side wired—shallower for more wire room
- Takes polarized or standard caps



Featuring an entirely new principle, the Hubbell SP-49 Receptacle was designed to reduce the possibility of accidental shock and burn, makes contact ONLY when standard caps are inserted! Pins, wires or other foreign objects cannot energize the unit! The SP-49 provides easier wiring, more wire room, back wiring, washer ears, silver plated contact springs, interlocking bridge and takes standard caps.

For descriptive literature write

HARVEY HUBBELL, INC.

Dept. E-1 Bridgeport 1, Conn.

ARE YOU SECURING THESE THREE BENEFITS OF HAZARD PERFORMITE BUILDING WIRE?

The advantages you gain from Hazard Performite Building Wire, Type RH, are simply the logical results of using better insulation which permits a lighter-weight, smaller-diameter wire for a desired circuit amperage.

Performite Insulation, with its high heat-resistance, (20% greater current carrying capacity than Code grade) means that smaller conductors, voltage drop permitting, carry the same load with greater safety. Thus, particularly on #1 Awg wire and larger—you save initially on copper cost and lower shipping weight . . . handling and installation are easier and therefore quicker with this lighter, more compact wire . . . its smaller overall diameter permits smaller, less costly conduit and fittings. And the better grade rubber used in compounding Performite Insulation assures many extra years of safe service.

If you're not already taking advantage of Hazard Performite Type RH Building Wire, it will pay you to talk to your Hazard representative before planning your next installation. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pennsylvania.

Quick Comparison Chart of Typical Savings with Performite Type RH Building Wire for Five Common Circuit Amperages Where Voltage Drop Is Not Excessive.

TYPE	SIZE AWG	O.D.	WEIGHT PER 1000 FT.	CONDUIT FOR 3 CONDRS.	APPROX. SAVING PER 1000 FT.*
100 AMPERE CIRCUIT					
R	1 (110 Amps.)	.56"	364	1½"	
RH	2 (115 Amps.)	.48"	278	1¼"	$24.00
200 AMPERE CIRCUIT					
R	250,000CM (215 Amps.)	.84"	962	2½"	
RH	3/0 (200 Amps.)	.70"	663	2"	$73.00
285 AMPERE CIRCUIT					
R	500,000CM	1.09"	1815	3"	
RH	300,000CM	.90"	1139	2½"	$149.00
380 AMPERE CIRCUIT					
R	700,000CM	1.27"	2512	3½"	
RH	500,000CM	1.09"	1815	3"	$155.00
400 AMPERE CIRCUIT					
R	750,000CM	1.30"	2673	3½"	
RH	600,000CM	1.20"	2177	3½"	$38.00

*These savings are only on copper. Additional savings also result from smaller conduit and fittings; lighter-weight, easier to handle and install wire. Your Hazard representative will be glad to work out an estimate for you of overall savings for a given job.

HAZARD

7339

insulated wires and cables for every electrical use

SORGEL AIR-COOLED TRANSFORMERS

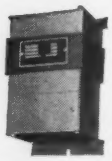
For every purpose

Dry-Type

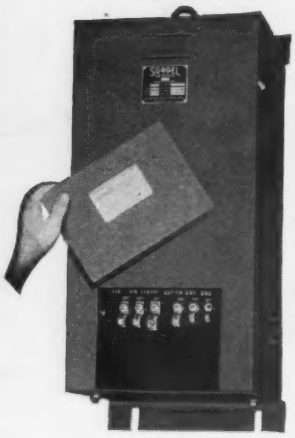
¼ to 1000 Kv-a. single phase.
1 Kv-a. to 2000 Kv-a. 3-phase.

To operate 115 volt lighting and portable equipment from 230/460 or 575 volt power circuits.
To operate special equipment from standard circuits.
To change odd voltages to standard voltages, and phase changing.

100 Kv-a. Single Phase. Floor Mounting Type.



¼ Kv-a. Single Phase. 460/230 to 115 volt.



15 Kv-a. 3-phase. Wall mounting type. Showing connection compartment with solderless terminals.

Also Unit Sub-Stations

For interior high voltage distribution systems with transformers at load centers. Sizes up to 2000 Kv-a. and up to 15,000 volts.

With primary switchgear, secondary circuit breakers and metering, as required —all complete, factory assembled, stream lined, steel encased unit.

Sales engineers in principal cities

SORGEL ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled transformers

SYNTRON

DEPENDABLE

ELECTRIC HAMMERS

Will Prove Their MONEY and TIME SAVING ABILITY

On Job After Job

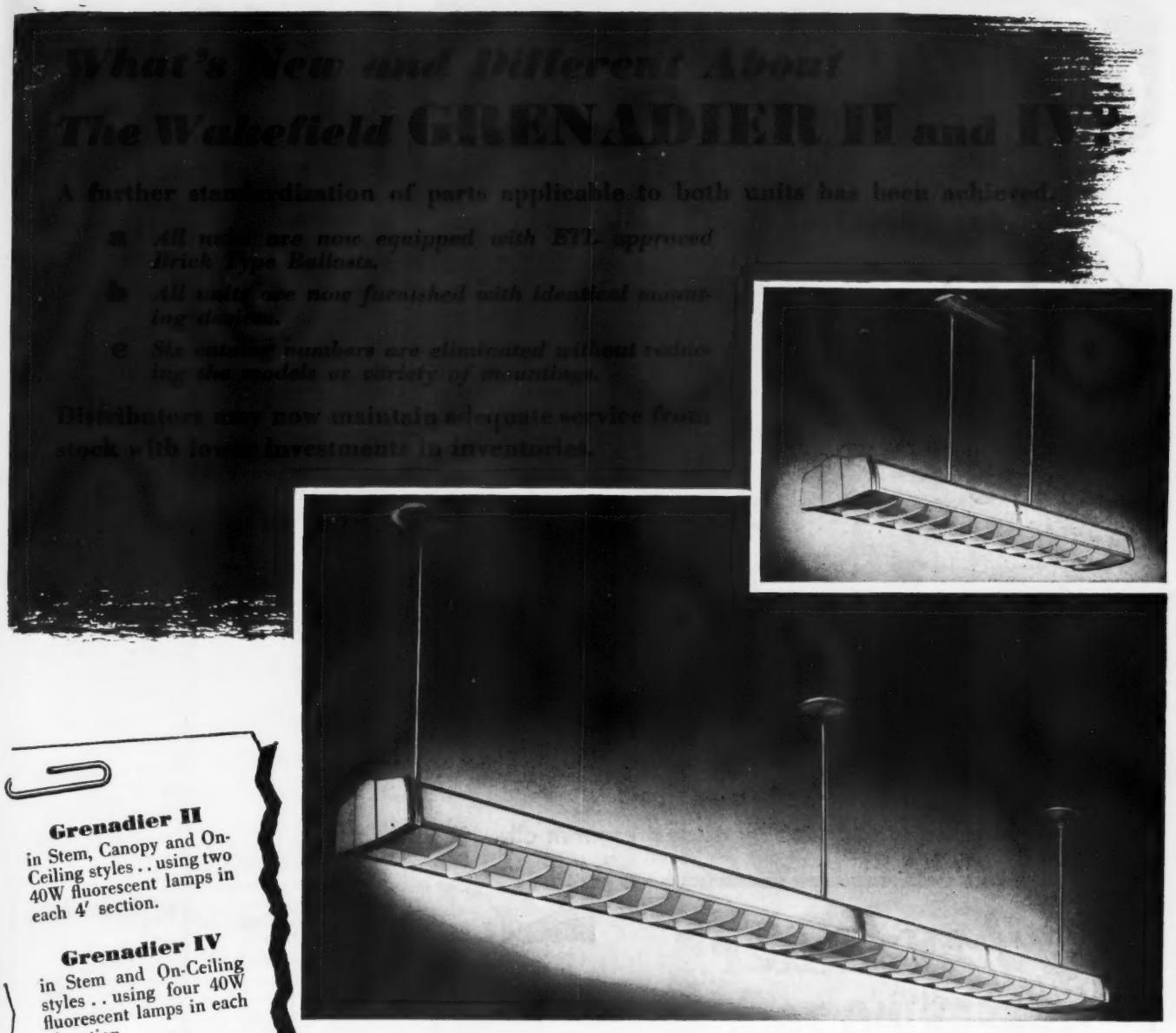
Drilling expansion bolt holes for panel mounting.
Cutting and Chipping openings for conduit and duct work.

Ruggedly constructed to produce the 3600 powerful blows per minute that make short work of drilling, cutting and chipping concrete and masonry.

Write for Illustrated Folder

SYNTRON CO.

690 Lexington Ave. Homer City, Penna.



Grenadier II
in Stem, Canopy and On-Ceiling styles . . using two 40W fluorescent lamps in each 4′ section.

Grenadier IV
in Stem and On-Ceiling styles . . using four 40W fluorescent lamps in each 4′ section.

In classroom, office, drafting room and store installations the Wakefield Grenadier has earned respect for

1 *its ability to provide a highly efficient type of diffused lighting;*

2 *design and construction features which make maintenance and part replacement simple and rapid, resulting in a "low cost of owning";*

3 *the quality and beauty of its construction throughout and particularly of the metal-framed plastic side panels and the soft metallic satin finish of all metal parts.*

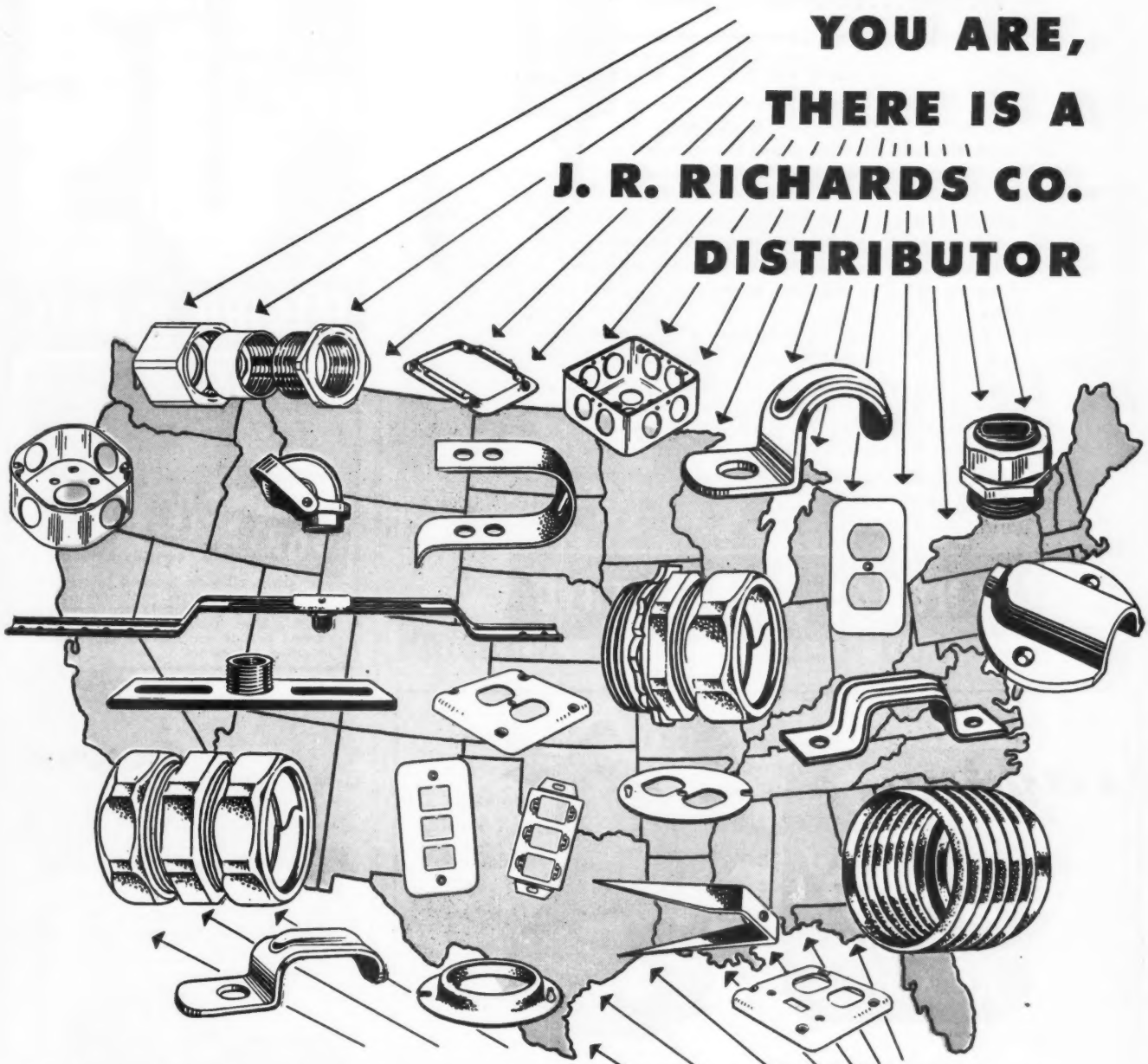
To these superiorities must now be added the new benefits of parts simplification noted above. Good news, we think, for all who stock, sell, specify and install the Wakefield Grenadier.

Wakefield **Over-ALL Lighting**

A BASIC CLASSROOM TOOL

– Quality Fittings for Every Electrical Job

WHEREVER YOU ARE, THERE IS A J. R. RICHARDS CO. DISTRIBUTOR



READY TO SERVE YOU

J. R. Richards Company distributors, with a complete line of Richards' electrical outlet and switch boxes, covers, fittings and specialties, are as close to you as your 'phone! Centrally located sales representatives assure you of fast, reliable cooperation, and an EXPERIENCED organization assures the kind of forward-thinking distribution and supply that will help you keep your stock and facilities up to date. Progressive, modern ideas, along with a new streamlined manufacturing plant, assures you of quality, latest designs, quicker installation at lower costs.

Write today for copies of our new bulletins and ask for the name of your local Richards' distributor.

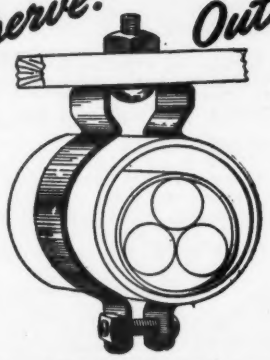
THE J. R. RICHARDS COMPANY

CARNEGIE PENNSYLVANIA

MINERALLAC

Steel HANGERS, CLIPS, STRAPS

Outserve! *Outlast!*



Minerallac Cable, Conduit and Messenger Hangers are STEEL. Easier, quicker to install; permit speedy, compact wiring; economical. Also in Everdur . . . Porcelain Insulating Bushings available.

• • •

Jiffy STEEL Clips (Pipe-clamp) require only one screw, nail or bolt; rib-strengthened; for hanging pipe, conduit, BX cable, mounting coils, etc. Millions in use.

• • •

Steel Straps for Messenger-cable services on outlet boxes; may be used in conjunction with hangers.

• • •

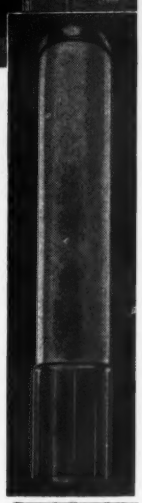
Order from your Electrical Wholesaler. Send for literature.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street Chicago 7, Illinois

NEW BUSINESS for CONTRACTORS

The big development in outside business lighting is to the "new method of lighting" made possible by Post-Liter, the new all-weather fluorescents. These dramatic, stream-lined lights radiate light in all directions. They completely dominate any surroundings. Visible a mile away. Attract business like nothing else can. One installation sells others. This is your big opportunity!

Post-Lites are well engineered by a 38 year old company. Good in zero weather. Wide variety of types install on posts, walls, corners. Mail coupon for new Catalog.



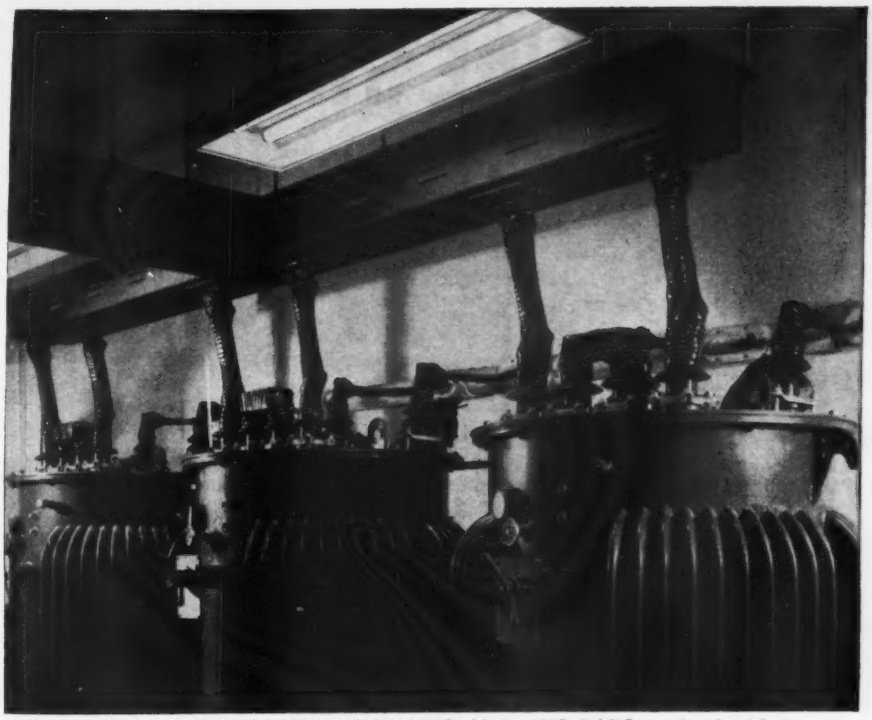
Round Post-Lites straddle pipe posts. Half-round Post-Lites mount on walls. Also other models

W. H. LONG CO., 108-114 W. Illinois St., Chicago 10.

Please mail Catalog and Prices.

Name .....

Address .....



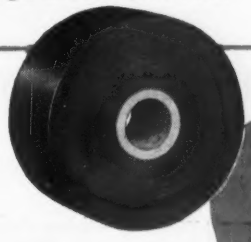
CONNECTORS BETWEEN TRANSFORMERS AND BUS BARS insulated with just one tape — "SCOTCH" Electrical Tape No. 22. Note compact, neat installation — by Buffalo Electric Co., Buffalo, N.Y. — on these three 500 KVA transformers.

One tape does the work of three insulating materials!

Tough, plastic-backed "SCOTCH" Electrical Tape No. 22 replaces three conventional insulating materials—two tapes, one coat of shellac—in modern electrical installations. This tape—or the narrower "SCOTCH" No. 33 Electrical Tape—gives high dielectric and mechanical strength, together with thin caliper and elasticity. Use one of these new tapes for your next job—on splices or bus bars or wherever you want a quicker, neater more efficient installation. There's a "SCOTCH" Electrical Tape ready to do any one of your jobs *better*. One of our Tape Engineers will be glad to show you how. Write Dept. EC-7 for more information—samples. No obligation.

Quick Facts About "SCOTCH" Electrical Tape No. 22

- **TOUGH** — Plastic backing is abrasion resistant, unaffected by water, acids, alkalies, alcohols.
- **STRETCHY** — 100% elongation at break, conforms snugly to uneven surfaces.
- **THIN CALIPER** — black plastic backing only 10 mils thick, takes less room in junction boxes, conduits, fittings.
- **HIGH DIELECTRIC STRENGTH** — insulates against charges of over 7,000 volts.



SCOTCH BRAND *Electrical Tape* No. 22

ANOTHER 3M COMPANY PRODUCT

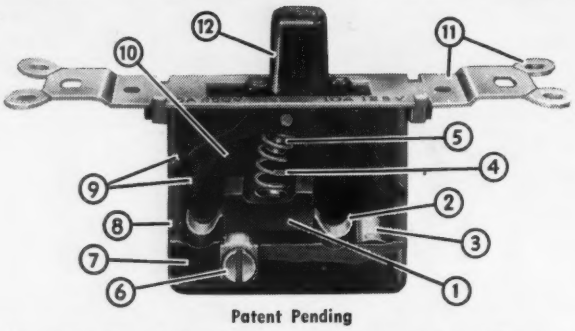
Made in U. S. A. by

MINNESOTA MINING & MFG. CO., St. Paul 6, Minnesota

also makers of other "SCOTCH" Pressure-Sensitive Tapes, "UNDERSEAL," "SCOTCHLITE," 3M Abrasives, 3M Adhesives.

General Export: DUREX ABRASIVES CORP., *New Rochelle, N. Y.*
In Canada: CANADIAN DUREX ABRASIVES LTD., *Brantford, Ontario*

FLUSH SLIDE SWITCHES



Patent Pending

After years of research and development, we are proud to offer our Heavy Duty FLUSH SLIDE SWITCHES for Residential and Light Industrial installations at competitive prices. Sturdy Mechanism utilizing new materials, assures a LIFETIME of dependable service.

IMPORTANT FEATURES

1. Oscillating Contact Block Molded of Monsanto's RESINOX
2. Concave Contacts of Heavy PHOSPHORUS BRONZE
3. Convex Terminals of HARD BRASS
4. High Tensile Steel Spring gives positive SNAP-ACTION
5. Actuating Lever of VULCANIZED FIBRE
6. Heavy Binding Screws, Will take up to No. 8 WIRE
7. Side Wired for convenience of installation
8. Box Molded of Monsanto's RESINOX, Natural Color
9. Completely enclosed Mechanism
10. Large Cooling Area
11. Aluminum Alloy Strap with Washer Type Break Off Plaster Ears
12. Large Size Handle, Available in Brown, Ivory, and Black

Write for Catalogue to Dept. E.

National Sales Representatives

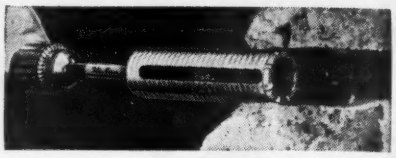
GEO. A. KUSHMAN CO., 428-Thirteenth Street, Oakland 12, California.

MANUFACTURERS

PHILISE SWITCH & MANUFACTURING CO., INC., 910-Third Street, Davis, California

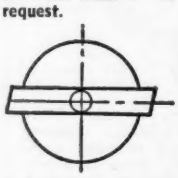
DRILL CONCRETE

2 to 6 inches per minute



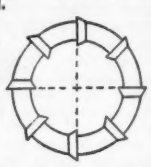
WITH THE REVOLUTIONARY TILDEN ROTARY CONCRETE CORE DRILL BIT, driven by ordinary electric drill

Up to 70% more efficient than pointed or solid drills. Leaves straighter, cleaner holes. Tilden Rotary Concrete Drill Bits are available in sizes from ¼" to 4" diameter. Quotations on sizes from 4" to 8" will be made upon request.



Ordinary pointed or solid drill (left) must drill FULL area of hole. Point of drill acts as pivot and retards cutting. Only one double cutter gives slow action. Slow-moving ⅛" center travels at only 13% of most efficient cutting speed.

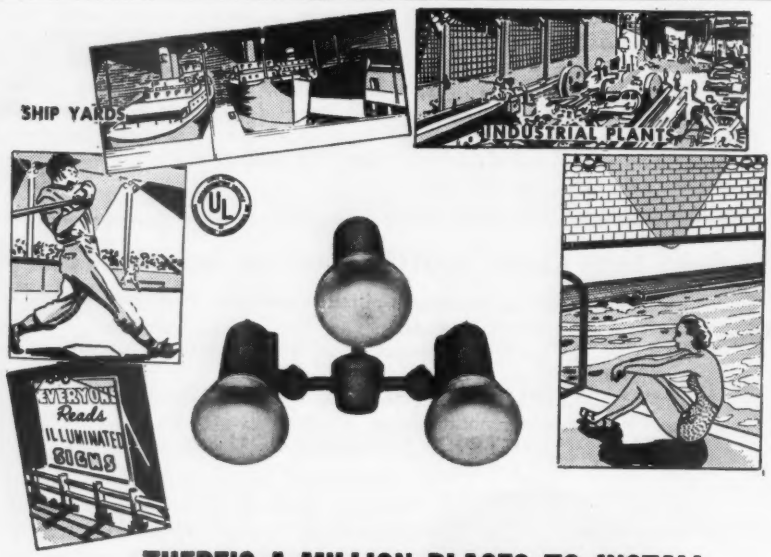
TILDEN CORE TYPE DRILL (right) drills much smaller area of hole. Has no point to retard cutting. All drills have from 3 to 24 cutters, depending on size of drill, which travel at best cutting speed, give fast, efficient action.



Write for catalog with complete details on this revolutionary concrete drill bit. DISTRIBUTORS: Inquiries welcomed.

TILDEN TOOL MFG. CO.

1995 N. Fair Oaks, Pasadena 3, Calif.



THERE'S A MILLION PLACES TO INSTALL

S T O N C O

MULTI-LITE SYSTEMS

More places than you've probably dreamed of! Outdoors—indoors and where moisture is present. Stonco has a list that will open your eyes. Why not send for it today. It's free.

Build your business with Stonco ideas—And build your repeat business with Stonco equipment. Its years of trouble free operation and economy will bring you the kind of satisfied customers that spell steadily increasing profit.

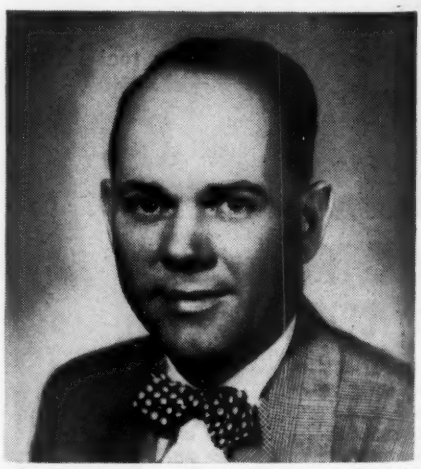
Sold exclusively thru recognized distributors *UNION MADE*

STONCO

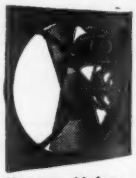
STONE MANUFACTURING COMPANY

489 Henry Street Elizabeth 4, N. J.

(ADVERTISEMENT)



Ed. C. Leverenz, Owner, Leverenz Electric Co., Danville, Illinois has joined the thousands of contractors throughout the country who are installing Herman Nelson Propeller Fans. Like others, Mr. Leverenz has found that it's profitable to sell these outstanding products to provide comfort and health in the huge industrial, commercial and institutional markets. He has also found that installing Herman Nelson Propeller Fans results in satisfied customers who help bring his firm more business. If you are interested in this profitable market, write for booklet, "1001 Ventilating Problems Solved."



Herman Nelson Propeller Fans

THE HERMAN NELSON CORPORATION

MOLINE, ILLINOIS

NEW BENJAMIN *"Series 40"*

Meet Your Lighting Plan's Most Exacting Specifications!

Yes, you'll find that your most exacting specifications for the newest developments in fluorescent lighting are fully met in the new Benjamin "Series 40"! In this new Benjamin Fluorescent Lighting Line are advancements which insure better shielding of the lamps from the eye, improved operation and easier installation and maintenance. In addition, there is advanced styling . . . the eye-pleasing beauty of streamlined design.

However, as is usual with all Benjamin Units, you get more than new features in the new "Series 40". You get famous Benjamin built-like-a-battleship construction and all the many other factors which go to insure efficient and easily maintained illumination of work places.

Recommend and specify Benjamin Fluorescent Lighting Units. Get the complete story—learn why you light right when you light with Benjamin. **BENJAMIN ELECTRIC MFG. CO., DEPT H, DES PLAINES 20, ILL.**

BENJAMIN

Lighting Equipment

Distributed Exclusively Through Electrical Wholesalers

R2447R

1. One-Piece Drawn Metal Housing
2. Ample Conduit Knock-outs
3. Accessible Non-Blinking Lamp Starters
4. "Lok-Latch" Fasteners for Low Cost Installation and Maintenance
5. Porcelain Enameled Shield
6. Life-Time Porcelain Enamel Finish
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Proper Voltage: An Efficiency Factor

Load center substations and voltage regulation can be directly linked to industrial plant efficiency.

By Marvin R. Kimbrell Jr.
General Electric Company
Baltimore, Maryland

THE goal of every industrial plant manager is maximum production. And there is a definite relationship between production efficiency and maintained rated voltage throughout the distribution system. This vital relationship is expressed by the phrase, "production drops as fast as the voltage".

Practically every type of electrical equipment utilized in industrial plants is designed to operate at some specified voltage. When electrical equipment operates at voltages above or below rated values, detrimental effects are introduced on the life and performance of the equipment. For example:

WHEN VOLTAGE IS 10% BELOW NORMAL

(a) Heating equipment of the resistance type, such as soldering irons and electric ovens, produces only about 80% as much heat as when normal voltage is applied.
(b) Induction motors have a 19% decrease in starting and maximum running torque; temperature rise is increased 6 to 7 degrees C at full load; maximum overload capacity is decreased 19%; efficiency is reduced 2%.
(c) Incandescent lamps have only 70% of the rated output.
(d) Fluorescent lamps have a 15% reduction in lumen output and a 20% reduction in life.
(e) Infra-red heating or drying processes have approximately a 15% reduction in heat output of the lamps, causing improper drying or a necessary slow-up in production line operation.
(f) In electronic equipment there are various types of vacuum tubes all of which may have reduced life due to undervoltage.

WHEN VOLTAGE IS 10% ABOVE NORMAL

(a) Heating devices operate at increased temperatures and thereby have a loss in life.
(b) Induction motors have a 21% increase in starting and maximum running torque; starting current is increased 10% to 12%, causing increased light flicker; power factor is decreased from 3 to 6 points depending upon load of operation.
(c) Incandescent lamps will operate for only 29% of their normal life.
(d) Fluorescent lamps have a 12% increase in lumen output and a 20% reduction in life.
(e) Infra-red heating or drying processes have approximately a 15% increase in heat output of the lamps causing overheating of paint finishes.
(f) In electronic equipment, reduction in life of the vacuum tube is even more serious with overvoltage than with undervoltage.

It is possible to mention many other detrimental effects resulting from improper voltages. However, these examples suffice to indicate that maximum production requires adequate and proper voltage. Due to low voltages, motors of electric motor-driven machinery may burn out because of prolonged starting or failure to start. Over-voltage will increase the maintenance of motor driven equipment. Adequate lighting, a factor proven predominant in plant production and efficiency, is lacking with undervoltage.

Improper voltage also means a definite loss in investment. For example; assume that a fluorescent lighting system is installed for $10,000. If the lighting engineer made calculations for this lighting system based on normal lamp voltage ratings, he would know the expected lumen output of the system. However, the lights, when installed, operate at a voltage condition 10% below normal, consequently there will be 15% less lumen output for the system than calculated. This means that for the $10,000 investment, only

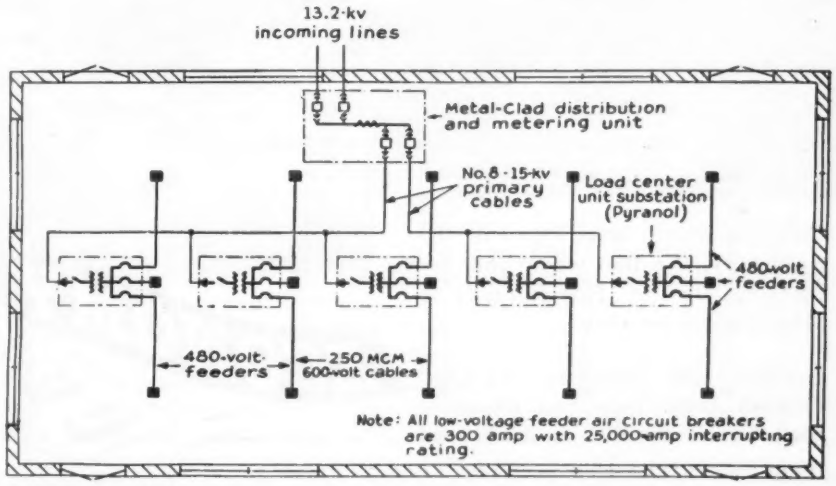


FIG. 1—Load center substations are recommended in large plants where power distribution is at 600-volt level or less. Efficiency of system and economy of equipment and materials are determining factors.

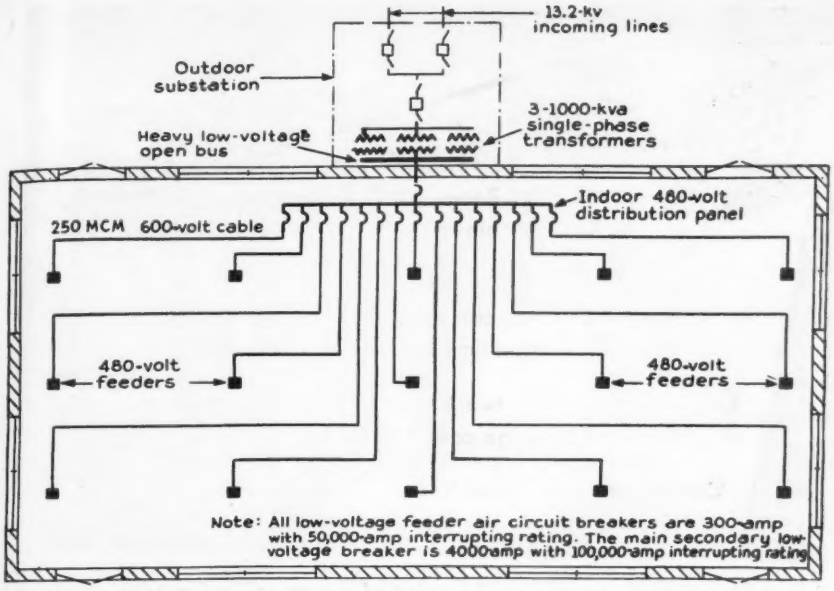


FIG. 2—Single substation plan, with longer secondary feeders to utilization points, introduces possibility of objectionable voltage drop between transformer bank and connected motors in the plant.

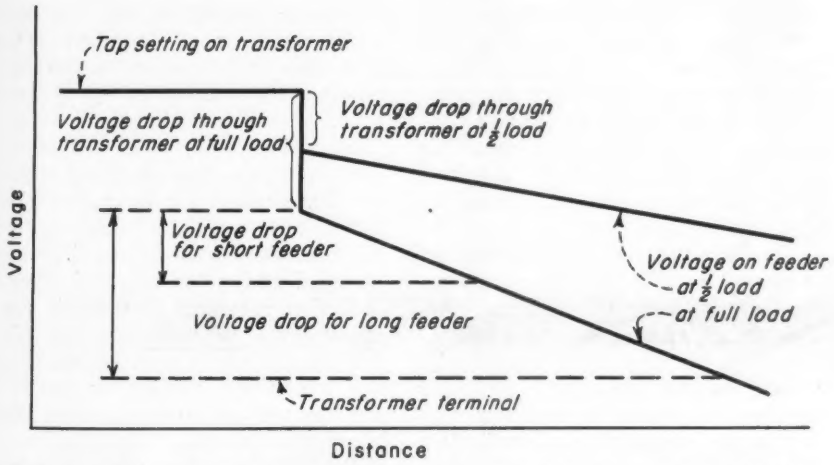


FIG. 3—Voltage drop is proportional to connected load on the distribution system and the length of the feeders.

about $8,500 worth of lighting is available—a $1,500 loss.

Also assume that, on a production line where small distribution transformer tanks are painted, there is an infra-red heat drying process. Also assume that the production rate is 60 tanks per hour through this drying process. When the voltage is 10% below normal, the heat output of the lamps will be 15% below normal. Thus, there would be a 15% reduction in the number of tanks that could pass along the production line, or the rate is reduced to only 51 tanks per hour through the drying process. If the particular manufacturer involved had opportunity to sell the finished product in this example at $50 each, it can be seen that with the slower production rate he is losing in one hour the profit considered on $450 worth of equipment.

Yes, there is a definite relationship between proper voltage and the efficiency of plant production. But how can proper voltages be maintained?

LOAD CENTER SUBSTATIONS

The first step is to analyze the system. Today, there are two fundamental types of power distribution systems for 600 volts and less: load center substation plan and single substation plan (Figs. 1 and 2). In the first case, the feeders are short, since the substation is located directly at the load center. In the second case, the low voltage feeders are longer—extending from the substation at one end of the plant to the many loads in the plant. For every foot of feeder cable length there is a loss in voltage due to the combination of impedance and current. Fig. 3 shows that even for a short cable, the voltage at the end will be slightly less than the voltage at the beginning Likewise, the voltage at the end of a long cable will be reduced even more. This means that the voltage difference between the load center substation transformer and the load will be relatively small. The voltage difference in a single substation plan, however, will be much greater.

The analysis above for the voltage difference on short or long feeders was premised on a consistent load or constant amount of current in the circuit. This is not always true, especially since there are several feeders or loads for each substation transformer. The load on the transformer will increase or decrease as electrical motor driven machines are started and stopped. The load will vary as electric furnaces are turned off and on. Wherever electrical apparatus is being energized and then de-energized there will be a fluctuating or varying voltage. This fluctuation in voltage will occur not only along the particular feeder to which a load is connected, but will occur also at the low voltage bus of the substation transformer and the variation passed along to other feeders from that substation. The voltage variation due to operating the substation under changing conditions of load is one of several disadvantages of the single substation plan. Greater efficiency is possible with the load center substation, since the voltage variation is negligible under the above conditions.

To better illustrate voltage variations due to changing load, assume that a substation transformer is connected to give 480 volts under no-load conditions. When a load is applied there is a drop in voltage in the transformer itself due to impedance and current. Thus, if full load is applied to the substation, the voltage at the substation transformer bus is, for example, only 460 volts. Assuming a 20 volt drop in the circuit due to impedance and current, the feeders now have 440 volts at their extremities. Now, let half of the load be dropped. The voltage at the substation transformer will increase to 470 volts and the voltage at the end of the feeders that are still energized will become 460 volts. This change in voltage is also illustrated in Fig. 3.

Consideration should now be given to another disadvantage of the single substation plan—that is, some feeders on the power distribution system using this plan will be short in length whereas others will be long. This then means that the voltage at the end of the short feeders will be higher than the voltage at the end of the long feeders. Thus some electric equipment operates at overvoltage while the rest operates at

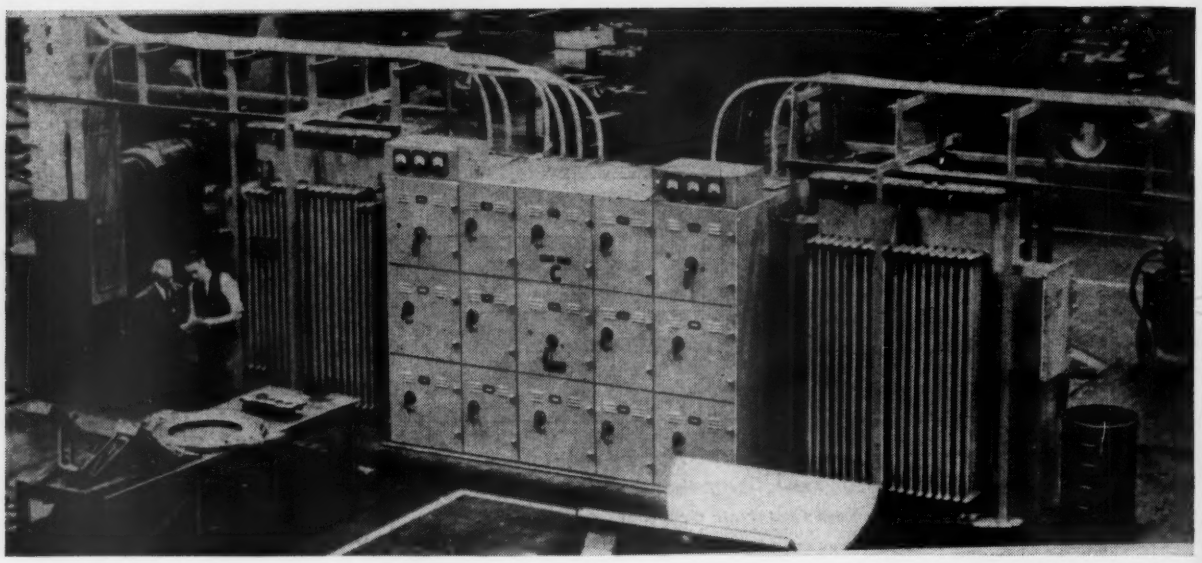


FIG. 4—Typical load center unit can be installed directly at the point of power utilization with maximum installational facility and operational safety.

a correct voltage. Or, it may be that some equipment operates at a correct voltage while the rest will operate at undervoltage.

This disadvantage is not found in the load center substation plan. For all the feeders are short in length and all equipment can operate at correct voltage.

There is another important consideration to be given to the load center substation plan, explained by again examining Fig. 1. When power is transmitted at high voltage, there is less voltage drop effect than when it is transmitted at a lower voltage. Fig. 1 shows that power required for distribution is carried at high voltage to the load center transformer and then stepped down to a lower voltage. In the single substation plan all of the electrical power is transmitted at the lower voltage, and this plan of distribution brings about poor voltage conditions on the system as previously explained.

Thus, from analysis, it is concluded that more consistent voltage is maintained by adopting the load center substation plan. Variable or improper voltage brings about losses in operating efficiency. This can be corrected through the installation of substations installed directly on the plant floor. (Fig. 4)

VOLTAGE REGULATORS

There may be, however, manufacturing plants where it would be desirable to change from the single substation plan to the load center plan but the expenditure of funds would not permit the change. Also in many industrial plants there will be some electrical equipment that requires even closer voltage control than that offered by the load center plan. Equipment is available for the purpose of securing voltage control when either of the above two conditions are encountered. It is possible to maintain constantly a proper voltage on all feeders through the application of voltage regulators. The particular type of regulator that best fulfills this application is the induction type voltage regulator.

The induction voltage regulator is, in effect, simply a variable ratio autotransformer having two separate windings, namely, a primary and a secondary. The primary can be rotated with respect to the stationary secondary winding and thereby a change in voltage on the secondary is effected. It is possible to obtain this change in voltage by means of a hand motor pushbutton, or automatic motor control. With automatic operation of the induction voltage regulator the controls are sensitive to voltage variations on the output side due to load changes or other causes. Should the load increase, so that the voltage drops, there will be an immediate change in the position of the primary winding so that voltage on the secondary is restored to its original set value. With the hand or motor control, an operator can vary the relative position of the primary and secondary winding to keep the output voltage at its required value. Induction voltage regulators, with controls as discussed above, are available in a wide range.

The automatic induction regulator is ideally suited for maintaining a constant voltage on circuits 600 volts and less which are supplying both lighting and motor driven loads. This is especially true where wide variations in loads occur as would be the case in all types of manufacturing plants. Where lighting and power are taken from the same substation bus as in the single substation plan, the automatic regulator will compensate for variations in the power load to maintain lighting illumination of the proper level.

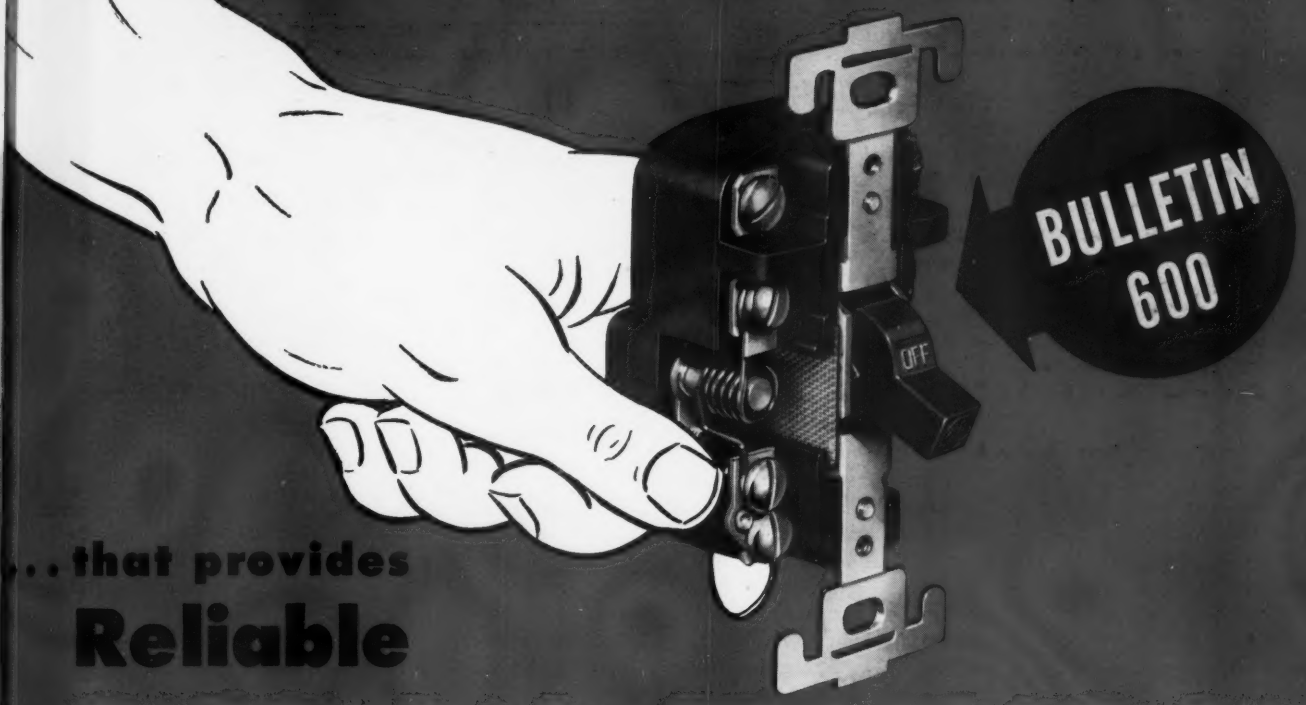
Many laboratory tests require constant voltage to guarantee that all tests are made under the same conditions. Other tests must be made at many different voltage conditions. The hand operated and motor operated types of induction regulator have made many applications in manufacturing plant laboratories where means of maintaining a constant voltage or means of varying voltage through a wide range would be desirable.

Since the induction voltage regulator is particularly required where the voltage variations of the single substation power distribution system are encountered, a few of the many applications are given below:

HAND OPERATED AND MOTOR OPERATED INDUCTION TYPE REGULATORS CAN—

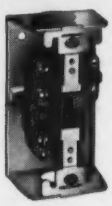
1. Provide low voltages for testing meters, relays, vacuum tubes, instruments, etc. in all types of testing or research laboratories where a variable range of voltage is desired.
2. Provide regulation of high voltage testing transformers which are used for breakdown tests of insulators and insulating material.
3. Provide regulation of high current testing transformers used for testing current transformers, oil circuit breakers, contactors, etc.
4. Provide control of voltage in all types of electric furnaces for heat treating purposes.
5. Provide lighting control through

A Compact New Starter for Fractional Hp Motors



. . . that provides Reliable

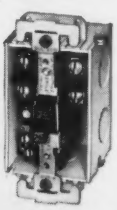
OVERLOAD PROTECTION



Open view of enclosure for surface mounting

Closed view of enclosure for surface mounting

Bulletin 600 Switch with waterproof enclosure



Bulletin 600 Switch fits any standard switch box

Here is a small, manually operated starter that will satisfy the latest ruling of the National Electrical Code . . . which requires overload protection for a great many fractional horsepower motor applications. The Bulletin 600 Starting Switch is built in the single- and double-pole construction, and is rated one horsepower and less. Its dependable thermal breaker trips the switch under a sustained overload, protecting the motor against burn-out. When the overload is cleared, the breaker is easily reset with the switch lever. However, the switch cannot be held closed so long as the overload condition remains.

The Bulletin 600 Starter is available in enclosures to meet every service requirement. Send for complete data. Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wisconsin.

A-B Quality

ALLEN-BRADLEY

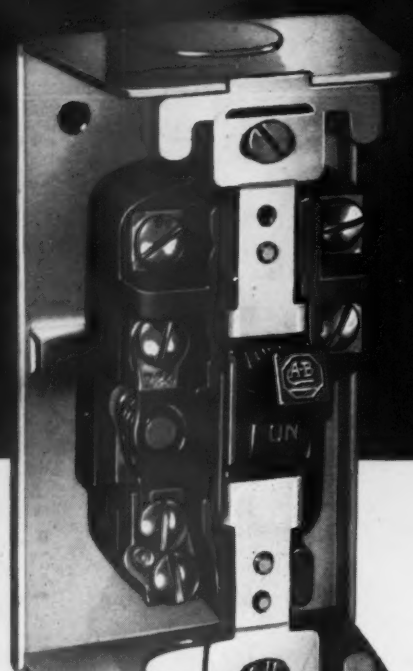
BULLETIN 600 STARTING SWITCHES

QUALITY

SEE OTHER SIDE

SAVE 30% to 40% of INSTALLATION TIME

on Starters for Small Motors (1 hp or less)



BULLETIN 600

Manual Starting Switches with Overload Protection

●

No Need to Remove Starter from Enclosure

Installation of the Bulletin 600 Starting Switch is so simple that contractors have saved as much as ten minutes in installation time. In addition, they have found the switch exceptionally reliable.

●

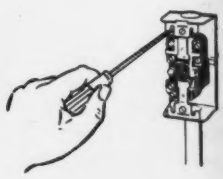
GENEROUS WIRING SPACE
ATTRACTIVE APPEARANCE
SIMPLE DESIGN

STEP 1—REMOVE COVER

Simply remove two screws on the front of the Bulletin 600 Starting Switch and the metal cover slips off, exposing the front and two sides of the switch.

STEP 2—MOUNT UNIT

Mount the switch on the wall with two screws. Conduit openings on top, bottom, and back permit easy connection. No need to remove the starter from the box.



STEP 3—PULL IN WIRES AND CONNECT

Because the compact mechanism allows ample space, wires can be pulled into the box and connected to the terminals without removing the switch from the enclosure.

STEP 4—PUT COVER BACK ON

Finally, with the job completed, the cover is slipped back on, and two screws hold it firmly in place. The entire operation is simple and easy. It saves time and money.

A-B Quality

ALLEN-BRADLEY

MANUAL STARTING SWITCHES FOR SMALL MOTORS

QUALITY

voltage control in theatres, auditoriums, photographic studios, etc.

AUTOMATIC INDUCTION TYPE REGULATORS CAN—

1. Provide a consistent proper voltage level for lighting in all types of industrial plants and office buildings.
2. Provide a closely regulated voltage for all types of testing and research laboratories where consistent voltage is desired.
3. Provide consistent motor speed for drive in textile mills, fabric mills, hosiery mills, etc., to prevent breakage and spoilage.
4. Provide proper and regulated voltage for hoists, cranes, shovels, elevators, and any other motor driven auxiliaries in industrial areas.
5. Provide a regulated voltage for all types of electrical heating processes and equipment.

Although it has been shown previously in this discussion that voltage variations are relatively negligible in the load center plan of power distribution, there are many applications for the induction voltage regulator in this system also. Particularly is it desirable to have a constant voltage where lighting circuits are concerned or where infra-red heating or drying processes are concerned. These types of electrical equipment are particularly sensitive to inefficient operation when voltages vary. The application of the automatic regulator to these circuits only would be advisable in the load center system. The hand and motor operated voltage regulators will also have the same application in the load center substation system as had been indicated above.

IN SUMMATION

The addition of more lamps to a lighting system does not always give the extra light expected, for lumen output can be reduced because of undervoltage. The addition of a larger motor to a crane would help the crane lift its load, but the present motor might be adequate if it had the proper voltage. Results from laboratory tests often vary, but these variations may be due to erratic voltage conditions, rather than to the product or equipment on test.

Requirement of providing adequate, proper voltage will be fulfilled on circuits 600 volts and less through the general application of load center substations and specific applications of induction voltage regulators. Since maximum production depends on plant efficiency, which is greatly influenced by voltage level, it becomes apparent that production is a direct function of proper voltage and varies with voltage fluctuations.

Important news for you!

Lowest prices! Fastest installation! Instant delivery! . . . Now you can assemble in minutes the new, exclusive Federal Noark Flexunit Plug-In Distribution Panelboard

IN THE DISTRIBUTION PANELBOARD FIELD the whole picture has been changed by a brand new Federal Noark development. Now you can assemble Plug-In Distribution Panelboards to your exact requirements – from the wholesalers' stock of standard parts. It takes only minutes . . . slashing installation costs. No more waiting for factory assemblies. And what's more, through mass production the Federal Noark Flexunit Plug-In Distribution Panelboard sells for less.

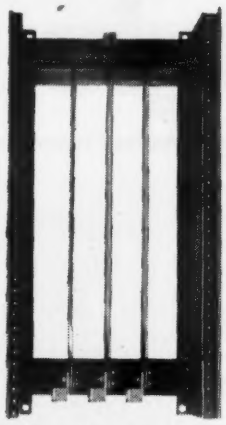
Four standardized surface cabinets in two sizes of main lugs (200 and 400 ampere), provide for a maximum of:

★ Twenty-four 30 ampere, 3 pole, 230 volt or sixteen 60 ampere, 3 pole, 230 volt branches in a panelboard for 230 volt service.

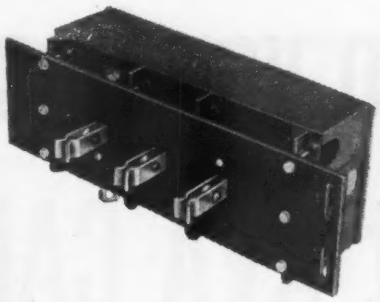
★ Lesser combinations of 30, 60, 100 ampere, 575 volt units; or 30, 60, 100, 200 ampere, 230 volt units may be assembled in a Flexunit Plug-In Distribution Panelboard.

★ Filler plates to cover unused spaces are available in four sizes.

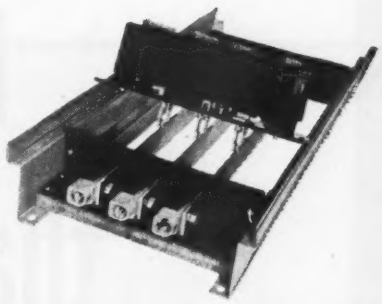
Start cashing in today on the faster service and lower prices offered by Federal Noark Flexunit Plug-In Distribution Panelboards. Mail the coupon for complete data on this revolutionary new improvement. Federal Electric Products Co., 50 Paris St., Newark 5, N. J.



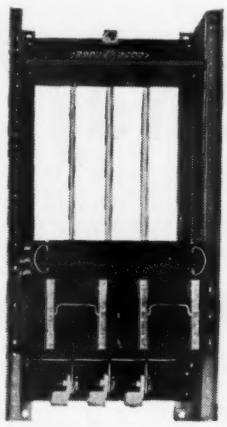
1 Federal Noark chassis has three silver-plated copper bus bars, of 200 or 400 ampere rating, arranged on edge to receive the plug-in units. Spacing ample for 575 volts! Neutral provides for 3 phase, 4 wire; and single phase, 3 wire services.



2 The rugged plug-in Flexunits are complete with fusible pull switches. They are available with twin 30, twin 60, 30-60, twin 100 and single 200 ampere switches for 230 volts A.C. Twin 30, twin 60, 30-60 and single 100 ampere switches for 575 volts A.C.

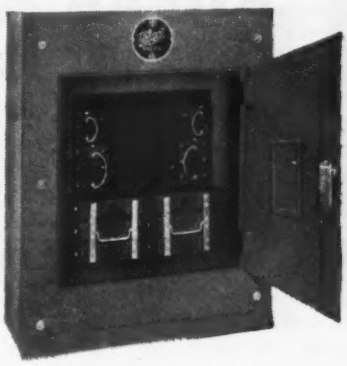


3 Snap! . . . and the Flexunit is in place. When secured by screws, the popular Wurdack pull switch units are ready to operate with a simple pull, turn and push. Designed for absolutely positive action, they clearly indicate "On" and "Off" positions.



4 Here, mounted in the chassis are two plug-in Flexunits. Unused space can be covered with filler plates giving a dead front panel when the panelboard is completed. Then additional Flexunits can be added simply, easily, as needed.

5 Note the ample gutter space available when chassis is mounted in the box. At the top are the neutral bar and terminals so that panel can be used on the increasingly popular three phase, 4 wire service, as well as on single phase, 3 wire service.



6 The completed Federal Noark Plug-In Distribution Panelboard assembled with twin 30, twin 60 and twin 100 ampere fusible Flexunits and narrow filler unit at top. Both box and trim are code gauge steel, complete with standard hardware.

7 All essential elements of the new Plug-In Distribution Panelboard have been proved through years of outstanding service. The plug-in stabs are a well-known feature of both Federal Noark Bus Duct and Control Center plug-in units. The Wurdack pull switch units are recognized as standard, everywhere! Get the complete facts. Mail the coupon, right now!

Federal Electric Products Company,
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Gentlemen: Please send me full data on the Federal Noark Flexunit Plug-In Distribution Panelboard for better service, lower installation costs.

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Company name.....

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City..... Zone..... State.....

Name of our wholesaler.....

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FEDERAL NOARK

FLEXUNIT PLUG-IN DISTRIBUTION PANELBOARDS

Complete line of Federal Electric Products includes Motor Controls, Safety Switches, Service Equipment, Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct ★ Sales offices in principal cities.

Do you know that AVA CABLES can deliver up to 49% extra current per raceway?*

Yes, wherever sizable electrical loads are carried in dry locations,† you may find substantial installation savings in General Electric Deltabeston® AVA cables.

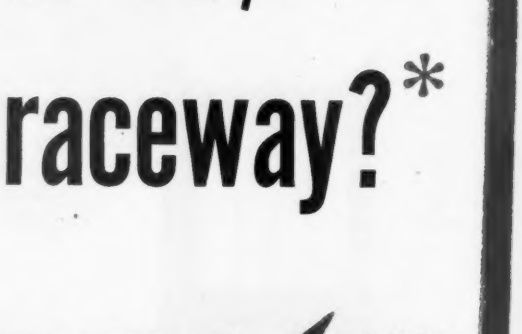
Used for years in industrial spots where operating heats are high, Deltabeston cables carry high current ratings. Used at normal ambient temperatures, they can safely carry far greater loads for their size than ordinary Type R building cables. Because they are insulated with heat-beating asbestos, they can actually deliver up to 49% more current per raceway.

• To you, Deltabeston AVA cables mean *installation speed*, because they can help on many jobs by cutting the number of cables you put in—*material savings*, because AVA cables can deliver extra current per raceway—*weight savings*, because small size means light weight.

It will pay you to begin planning with your electrical contractor for Deltabeston AVA cables. For information, write to Section Y32-718 Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut.

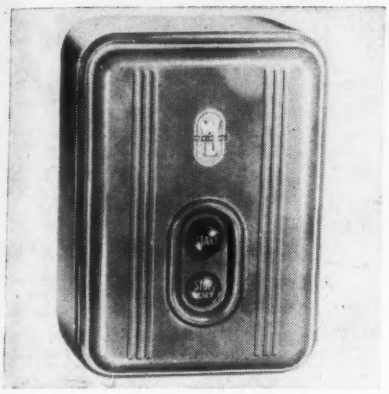
† *As defined by the National Electrical Code.*

* The figure above was worked out for AVA cables at 1000 MCM. Larger and smaller sizes give similar savings.



GENERAL ELECTRIC

Equipment News



Starter

Bulletin 3151 Size 0 and 1 a-c manual across-the-line starters designed for application with single or polyphase a-c motors have been developed. They consist basically of a mechanically actuated quick make and break switch mechanism with thermal overload protection. Components are housed in NEMA Type 1 general purpose enclosures. Features include; front-operated, silver to silver double break contacts, manually reset inverse time delay thermal overloads, interchangeable overload heaters. Available in 2, 3 and 4 pole forms. Maximum enclosed three phase rating for Size 0 is 2 hp., 440-550 volts, 60 cycles and for Size 1 7½ hp., 440-550 volts, 60 cycles. *Ward Leonard Electric Co., Mount Vernon, N. Y.*

Clamp

A tin-plated copper alloy line clamp for connecting copper, Copperweld, A.C.S.R., steel, or combinations of these conductors, is now available. Recommended for light duty in rural distribution or similar service, the new parallel clamp features interlocking fingers designed to accommodate a large range of cable sizes. High gripping pressure is provided by a plated steel bolt. *Burndy Engineering Co., Inc., 107 Bruckner Blvd., New York 54, N. Y.*

Fluorescent Lamp

Addition of a six-foot long tube to its "fat slimline" series of fluorescent lamps has been announced. It is expected to be used in offices and restricted areas such as show windows, showcases and coves which are too small to accommodate the eight-foot-long lamp after which the new tube was modeled. Diameter of both lamps is one and one-half inches. Lamp will be offered as various loadings, from .400 to .600 amperes. Named the 72T12, it starts instantly. *Westinghouse Electric Corp., Lamp Division, Bloomfield, N. J.*

Louvered Lighting

A new line of commercial fluorescent louvered lighting, known as Paralier Series, has been introduced. It offers a complete lighting package of matched fixtures consisting of 2 and 4 light exposed "Forty-Eight"; 2 and 4 light exposed Slimline (T-8 or T-12 lamp); a troffer system in "Forty-Eight" and slimline built on 2 light, 12 inch modules (for accoustical blocks) that can be combined in width as well as length; and one and two light incandescent spotlights for all. Any fixture in line can be surface or pendant mounted, individually or in continuous runs. *Moe-Bridges Corporation, Sheboygan, Wis.*

Dimmer

A new Powerstat dimmer with a rated capacity of 0 to 850 watts has been announced. Known as Type D850H, it operates from a 115 volt, 50 or 60 cycle, single phase source. Built as a continuously-adjustable auto-transformer to give stepless dimming, brightening or blending of lights, unit can be mounted in existing switchboards or lighting control panels. It measures 7 inches by 8½ inches. Unit is of the non-interlocking type, mounted on a black, wrinkle finished 14 gauge steel panel. *Superior Electric Company, Hannon Avenue, Bristol, Conn.*

Code Call Unit

A new code call unit has been announced. When a person fails to answer telephone, operator presses button broadcasting that person's code call number three times on signaling devices located throughout the premises. Telephone call is completed through the nearest extension. Dial in position 1 is for standard 3-round call. When turned to position 2, it allows for continuous repetition call. An initial installation of 20 call stations can be increased to 40 calls at any time, without change in installation. *Signal Engineering & Manufacturing Co., 154 West 14th St., New York 41, N. Y.*

Instrument

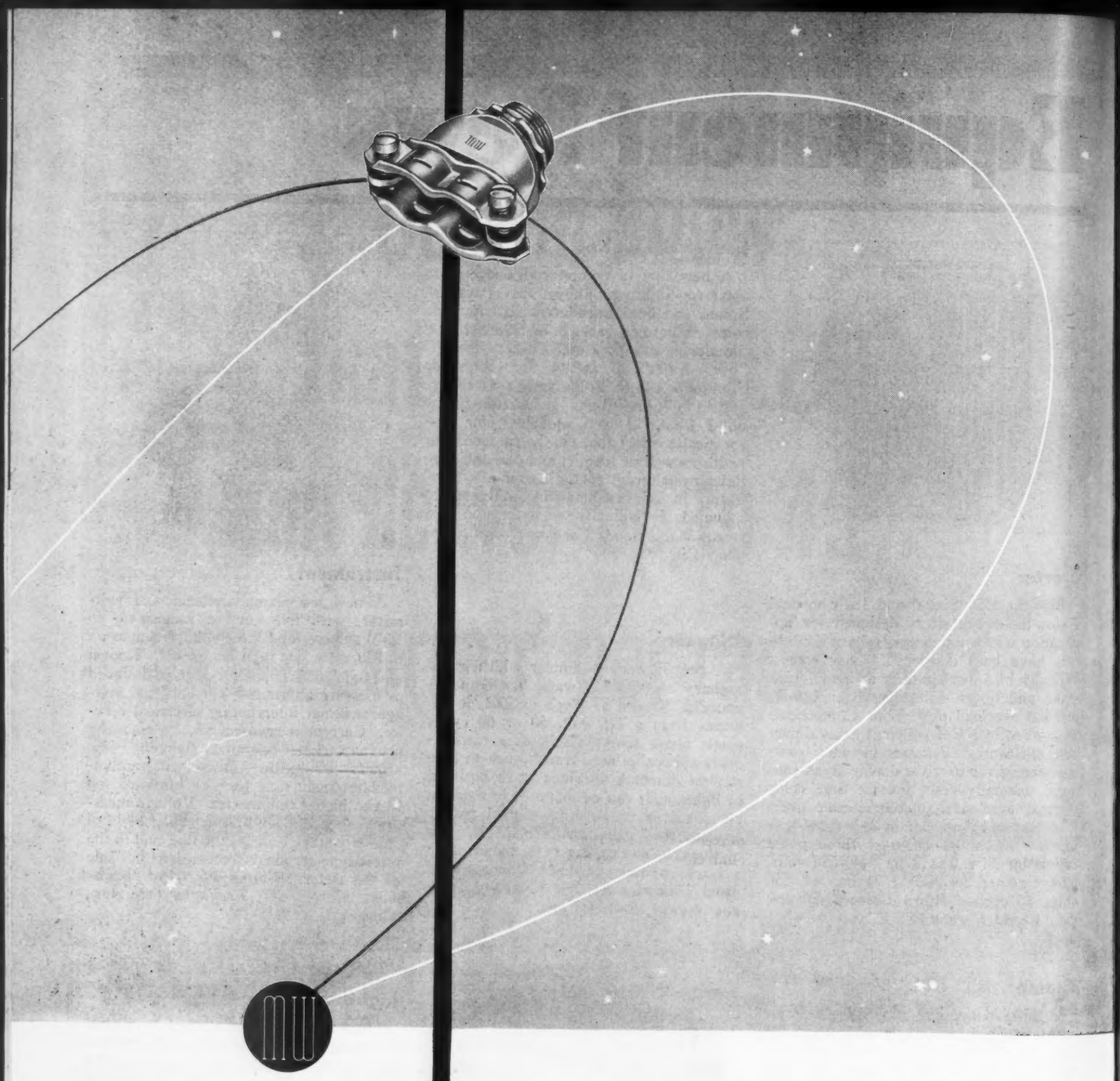
A new a-c clamp ammeter and voltmeter, with five current ranges up to 1,000 amperes and three voltage ranges up to 700 volts, has been announced. Known as Model 633 Type VA-1, it is designed to measure alternating currents and voltages without interrupting electrical service. Current measurements are made by placing trigger-operated clamping jaw around conductor. Jaws will accommodate conductors, bare or insulated, up to two inches in diameter. Voltage measurements are made by connecting a set of clip-on voltage leads to the line, and to the screw-type terminals recessed in the side of the meter. *Weston Electrical Instrument Corp., 617 Frelinghuysen Ave., Newark 5, N. J.*

Lighting Fixture

A new series of louver slimline luminaires for commercial and industrial interiors has been announced. They are designed for use with the 96-inch slimline fluorescent lamp and are a semi-direct type. Two types are available, a 2-lamp 96-inch unit and a 4-lamp 96-inch unit. They are instant starting. Push-in type lampholders are provided, and steel connector straps for locking adjoining channel sections together when mounting in continuous rows. Fixtures can be mounted to ceiling or suspended. *The Miller Company, Meriden, Conn.*

Lighting Fixture

The Trucolite reflector is now available for slimline lamps. It is made in two four foot sections. Construction makes it possible for one man to install them. They may be used as open unit, with eggcrate louvres, or diffusing glass panels. *Edwin F. Guth Company, 2615 Washington Ave., St. Louis 3, Mo.*



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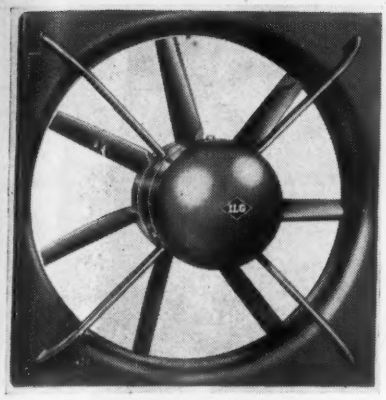


Fan

The Ilgfarmaire, a 42 inch direct-connected fan, designed for farm drying and curing operations, has been introduced. Fan mounts a cast-aluminum, non-overloading fan wheel which operates against resistance set up by products being dried. Steel panel has streamlined inlet for fan efficiency. Ball-bearing capacitor motor is 5 hp., 1140 rpm., 20 volt, 1 phase, 60 cycle. Handles practically all cribs and mows, with delivery of 25,000 cubic feet of air per minute at ½ inch static pressure and 20,000 cubic feet per minute at ¾ inch static pressure. *Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.*

Lighting Fixture

A new louvered fluorescent lighting fixture designed for the 75-watt T-12 instant-start slimline fluorescent lamp has been announced. It is particularly suitable for installations which call for long rows of light. It holds two 8-foot lamps. Fixtures can be either surface or pendant mounted and may be joined end to end to form a continuous row, with one joining assembly replacing the end caps. For pendant mounting, a single stem is used at each end of fixture, whether units are used singly or in continuous row. Fixture carries Underwriters' approval. *Sylvania Electric Products Inc., 500 Fifth Avenue, New York, N. Y.*

Connectors

New ¾ inch connectors, known as "Harbot", for attaching armored cable to knockout boxes in electrical installations have been introduced. They form a rigid fitting which protects wiring from damage. Recommended for installations where vibrations exist. Made of aluminum die-cast alloy. Each of two parts has a grooved lip which engages the edge and inside surface of a standard ⅞ inch knockout opening. Operating on a cam-wedge principle, it is possible to install connector from outside of box after wiring hook-up is completed. They carry Underwriters' approval. *Unimatic Corporation, 52 East Centre St., Nutley, N. J.*

Fluorescent Fixture

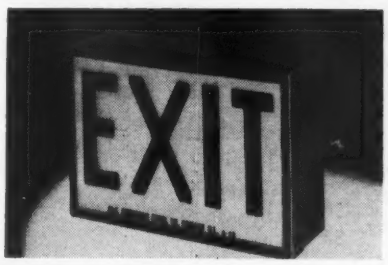
A new "PSB" series of fluorescent units designed for classroom lighting has been announced. They are furnished for two 40 watt, with turret type socket, four 40 watt and two 85 watt lamps. They are available with perforated, luminous sides or with solid sides. All units feature the "Travel-Hanger" which allows stem placement anywhere along length of unit, in conjunction with "Easy-On" suspension. Additional feature is the joiner channel for continuous row installations. *Spero Electric Corporation, 18222 Lanken Avenue, Cleveland 19, Ohio*

Ceiling Shutter

A new type ceiling shutter with a mercury switch that synchronizes the starting and stopping of the fan with the opening and closing of the shutter has been announced. When shutter is opened by pull chain, mercury switch starts fan motor, and when pull chain closes shutter, same mechanism causes mercury switch to stop fan. This eliminates danger of fan operating with a closed shutter, or vice-versa. It has a fusible link which, in case of fire, closes shutter and stops fans. Unit is adapted to both vertical and horizontal discharge of air. *Elgo Shutter & Mfg. Co., 2738 W. Warren Ave., Detroit 8, Mich.*

Industrial Fixture

The new industrial luminaire, known as Mazelite, features turret sockets for easy lamp changes. Also has a hinged reflector that is opened to either side or completely removed for cleaning. No springs, clips or nuts. Unit is of all-metal construction finished 300° metallic gray permalux with 300° white reflectors. *Edwin F. Guth Company, 2615 Washington Ave., St. Louis 3, Mo.*



Sign Boxes

A new series of "Exit" and "Fire Escape" sign boxes have been announced. Phosphorescence is used, which keeps the signs glowing long after all lights are out. They carry U. L. approval. Many cities and states have approved this type sign for installation without separate service. In many localities, they may be wired to present system. *All American Products, 141 W. Jackson Blvd., Chicago, Ill.*

New Equipment Briefs

Holtzer-Cabot, Inc., Boston, Mass. has anounced a self-contained, portable electronically controlled insulation resistance **tester** for engineers and maintenance men . . . . A new electrical adhesive **tape** with a high dielectric strength, 2000 volts, has been developed by Bauer & Black, Industrial Adhesive Tape Department, Chicago, Ill. . . . A twin line **connector** for television receivers and accessories has been announced by Grayhill, Chicago.

Spot-It is a new **circuit-marker** for identification of terminals, harness boards, switches and panels. It is made by Western Lithograph Company, Los Angeles, Calif. . . . Feiler Engineering Company of Chicago, Ill., has developed electrical appliance **tester** called the "Electroscope". . . . Professional Mfg. Co., Chicago, has announced a new light weight portable utility **ladder**, which holds on curved, flat or irregular surfaces.

Simonds Machine Company, Inc., Southbridge, Mass., has developed a new linemaster "Compact" **foot switch** . . . . Euclid Electric & Mfg. Co. of Madison, Ohio, has anounced a redesigned **centrifugal** switch for plugging, overspeed or underspeed protection, non-plugging and motion interlocking . . . . A new "safety fibre" **lamp guard** is being manufactured by the Safeguard Electric Company, Inc., Brooklyn, N. Y.

Arma Corporation, Brooklyn, N. Y. has announced a d-c **generator** that delivers an output voltage which is proportional to the acceleration of the rotor rather than the velocity of rotation . . . . Zero-Lite Products, Chicago, has announced a line of aluminum **extension ladders** . . . . Transvision, Inc., New Rochelle, N. Y. has designed hook-cut **pliers** for radio, television, electrical, electronic and other precision work.

Westinghouse Electric Corporation has developed a completely self-contained type CSP-C constant current **regulator** with all controls and accessories mounted integral with tank. . . . A multi-purpose, portable **electric tool** for maintenance men of all types has been announced by Smilan Tool Company, Los Angeles, Calif. . . . A new **bearing extractor** set for extracting motor bearings up to 4 inches has been announced by Walco Electric Products Co., Providence, R. I.

Ark-Les Switch Corporation, Watertown, Mass, has announced a **range switch replacement** kit for contractors and dealers' service departments. . . . A new portable **Moto-baker** for transformer, armature, stator and other windings is available from Miskella Infra-Red Company . . . . Inland Marine Corporation of Cleveland has designed a new type of marine **intercommunication system.**

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SAFETY SWITCHES

*Types A, C and D

Backed by 40 years' DESIGN LEADERSHIP

The remarkable superiority of this new switch line is reflected in these TYPE A design and operating features:

MODERN STYLING is both functional and attractive.

COMPACTNESS obtained without sacrifice of wiring convenience.

FULL COVER INTERLOCK has attachment that locks switch "ON" or "OFF" with 1, 2, 3 or 4 padlocks of nearly any size or shape.

SIMPLE MECHANISM—quick make-and-break action—no dead center.

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EXPOSED BLADES permit visual checks of switch operation.

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MAGNETIC ARC PLATE adds to unusually high rupturing capacity.

POSITIVE PRESSURE jaws and fuse clips, steel reinforced, silver-plated.

NON-TRACKING insulation used in base. Melamine insulating cross-bar.

REMOVABLE PRESSURE CONNECTORS permit substitution of solder lugs, where preferred.

Types **C and **D** similar to Type **A** in appearance—differ in construction details*

In production: 30 and 60 ampere sizes ***...NOW*** 100 and 200 ampere sizes ***...SOON*** Larger ampere sizes ***...LATER***

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In the News

N.I.S.A. Meets in St. Louis

Readjustment to new volume conditions, shop and operating problems, and management philosophy are studied at three-day conference.

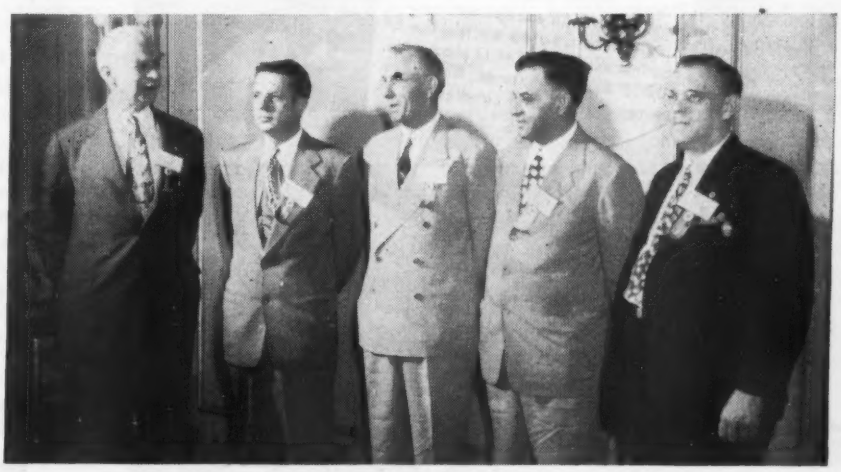
FOR the first time since the beginning of the war electric motor and equipment service shops are facing a volume dip that is making management wince. With overhead remaining substantially the same, this condition is whittling profits and in some cases producing unwelcomed losses. That was the unhappy, though highly realistic picture that evolved at the 16th Annual Convention of the National Industrial Service Association at the Hotel Jefferson, St. Louis, Mo., June 9-11th.

That immediate remedial steps must be taken to meet this situation was the consensus of the 600 registrants at the conference. Just how this was to be done was the subject of more than a dozen prepared papers and subsequent management and shop operating forums. Throughout the conference the terms "technical know-how", "customer service", "quality workmanship" and "operating efficiency" recurred at frequent intervals—gave an undisputed clue as to the thinking uppermost in the minds of management.

At the opening session, George C. Smith, president, St. Louis Chamber of Commerce, discussed the future of business in general. Delegates were told that the present recession was a healthy curb on inflation; that for the first time in nine years management can exercise selectivity of labor. Despite the general pessimism on the horizon, Smith can see no basis in fact to support fears of another 1929 depression. Smith is apprehensive about the general apathy of American business toward government. The danger this country faces is not an economic recession, rather a mental recession of business men on things politic, he warned.

Front office problems of management—markets, volume, administration, efficiency—were studied in several prepared papers as well as in forum groups. One important fallacy found in numerous owner-operated service shops is the tendency of one man to attempt to do everything in the shop and front office. Division of responsibility is the philosophy of Joseph F. Ferrari, Excel Electric Service Co., Chicago, expounded in his paper "What Is Your Goal in Business?" Rare is the man who can combine expert technical knowledge and shop technique with outstanding business ability. Human capacity has its limits, he pointed out. Ferrari suggested enlisting the services of a business specialist if you are a technical man, or vice versa; divide the business into shop and office sections, the former to handle all engineering, production, and technical matters, the latter to handle administration, accounting, sales promotion and other front office responsibilities. Once such an organization is developed, then investigate fields of expansion, such as equipment sales, transformer repairs, light manufacturing, specialties and other categories, Ferrari concluded.

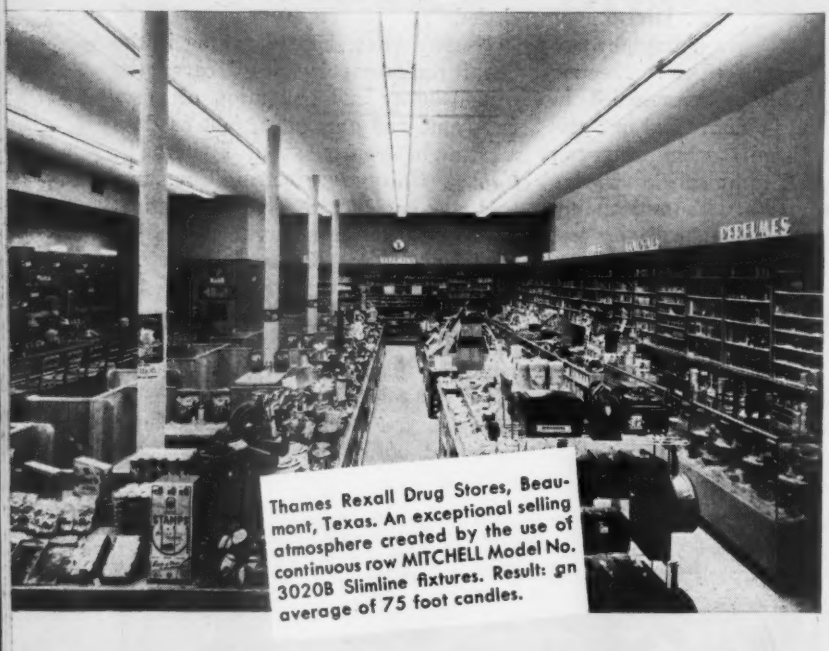
Those service shops engaging in the "used equipment business" carry the responsibility and obligation of service, value and guarantee, just as does a straight repair shop, Robert C. Kaska, Chicago Electric Company, told the assembled shop operators. This business has a moral as well as a technical side. Kaska believes one vital step in the fight for the present competitive market is the stabilization of values within the industry. This is not price fixing, but acknowledgment of a very definite price relationship between *new* and *rebuilt* equipment, he added, noting that this basic theory



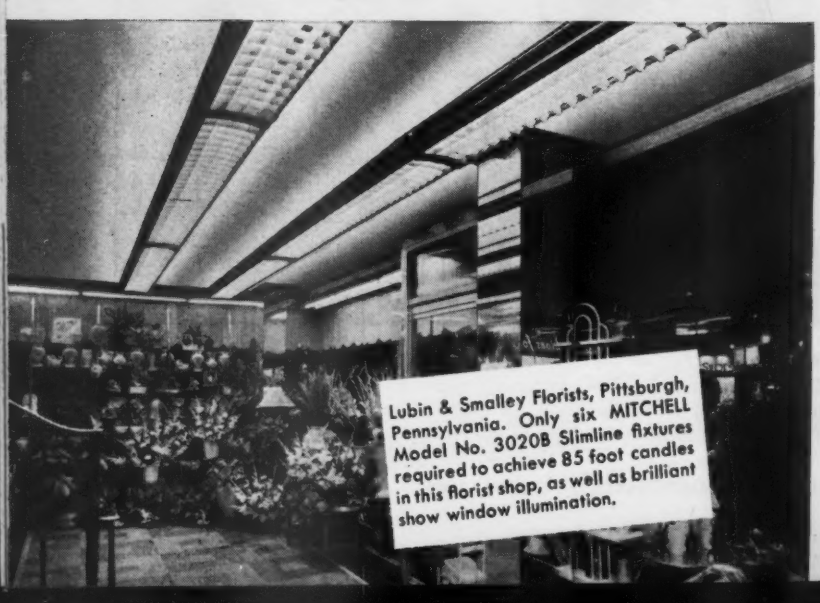
NISA OFFICERS elected for the coming year are: (L to R) Executive Secretary—Fred B. Wipperman, St. Louis; vice-president—H. Ed Grant, Nashville, Tenn.; secretary—M. F. Zack, Mason City, Iowa; president—R. E. Ward, Raleigh, N. C.; and treasurer—C. R. Durand, Allentown, Pennsylvania.

Model No. 3020—4-Lamp SLIMLINE with Louver

Clark Pontiac Company, Braddock, Pennsylvania. A modern automobile showroom completely lighted by MITCHELL Model No. 3020B Slimline fixtures to achieve an average lighting level of 50 foot candles.



Thames Rexall Drug Stores, Beaumont, Texas. An exceptional selling atmosphere created by the use of continuous row MITCHELL Model No. 3020B Slimline fixtures. Result: an average of 75 foot candles.



Lubin & Smalley Florists, Pittsburgh, Pennsylvania. Only six MITCHELL Model No. 3020B Slimline fixtures required to achieve 85 foot candles in this florist shop, as well as brilliant show window illumination.

Automobiles or Lilacs...

MITCHELL "SLIMLINE" Lights them All!

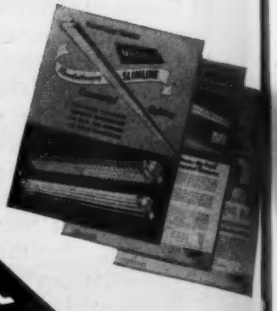
Right across the country, businesses of *every kind* are turning to MITCHELL "Slimline" to get the "selling" light they need. It's uncanny how one installation sells another—in whole communities the commercial lighting swing is to MITCHELL "Slimline".

Progressive businessmen prefer this handsome, smooth, powerful lighting that creates a traffic-building sales-inviting atmosphere. They like the way MITCHELL "Slimline" puts appeal into merchandise, makes it more desirable and easier to sell—the way it produces *measurable* increases in sales and profits.

This user acceptance builds volume business for the wholesaler. MITCHELL "Slimline" installations are easy, smooth jobs for the contractor—time-saving profitable business. And utility men can recommend this superior lighting with confidence.

Whether it's automobiles or lilacs—MITCHELL "Slimline" lights *and sells* them all!

Write for complete descriptive literature covering MITCHELL Slimline fixtures. Ask for Bulletin No. 322 describing 4-Lamp units; Bulletin No. 339 describing 2-Lamp units; Bulletin No. 334 describing spotlight units. for use with Slimline fixtures.



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First Choice in Lighting

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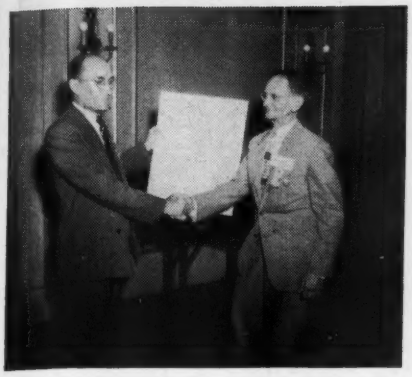
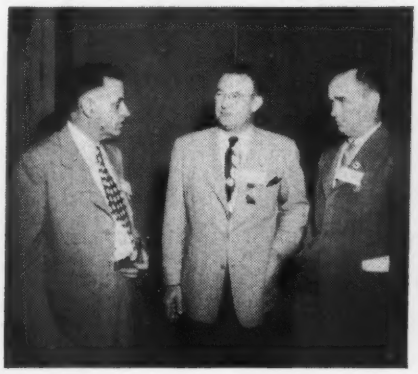


Selden F. High, Cincinnati, presents certificate of Director Emeritus of NISA to Frank W. Willey, Willey-Wray Electric Co., Cincinnati, Ohio, at conference luncheon.

Charles B. Kaska, Chicago Electric Co., Chicago; Roy A. Berentz, Roy A. Berentz Co., Inc., Houston, Texas; Paul G. Winter, American Electric Co., Indianapolis.

C. G. Smith and J. A. Milligan (left), Smith-Milligan Electric Co., Tulsa, Okla., chat with NISA treasurer C. R. Durand, H. N. Crowder, Jr. Co., Allentown, Pennsylvania.

Wm. H. Braunlich, Braunlich-Roessle Co., Pittsburgh, Pa.; and Joseph F. Ferrari, Excel Electric Service Co., Chicago, enjoy corridor chat at NISA convention.



R. E. Ward, Electric Motor Repair Co., Raleigh, N. C.; J. Arthur Turner, Tampa Armature Works, Tampa, Fla.; J. W. Wilson, Wilson Electric Co., Inc., Macon, Georgia.

F. M. Mielke, Mielke Electric Works, Duluth, Minn.; A. T. LeSuer, Central Electric Repair Co., Fairmont, W. Va.; George P. Svendsen, Boustead Electric & Mfg., Minneapolis, Minn.

has been ignored in the past. Kaska urged a return to this basis; an adherence to the NISA Code of Business Practice; and strict following of the NISA Electric Motor, Generator and Transformer Rebuilding standards to maintain the present recognition as an industry.

Another shop management problem is that of advertising. Shops have been using this to advantage in the past and probably will do more of it in the future. Just what type, how much and where advertising was used by shops was revealed in a survey conducted last fall by *Electrical Construction and Maintenance*. The results and an interpretation of same were presented at the conference by W. W. Garey, business manager, and W. T. Stuart, editor of the publication. The complete report appears in an article "How Motor Shops Sell" on page 58 of the June 1949 issue of *Electrical Construction and Maintenance*. Of the 180 motor shops answering the questionnaire, 96.1% advertise. Only one-third of those spend two percent or more of their sales dollar for advertising; 56.5% spend one percent or less, indicating a possible haphazard interest in advertising an industry not particularly pressed to sell at the time the survey was made. Undoubtedly this picture has now altered considerably.

As to media used, 127 of 179 answering use direct mail; 124, newspapers; 46, local magazines; 38, national or regional magazines; 15, radio; and four, billboards. Of 168 answering, 141 prepare their own ads; 39 use agencies; 20 use publishers' or printers' copy service. Some 32.7% of the shops felt they are spending too little on advertising; 7.4%, too much; 59.9%, about the right amount. Of those advertising, 91.8% felt their money well spent; 1.9% felt the money wasted; and 7.4% considered advertising a necessary nuisance.

The market for small motor repairs will still exist but the price differential between fractional horsepower repairs and new motors may shrink, according to H. E. Grant, Tennessee Electrical Motor Service, Nashville. Grant, a small motor specialist, warned the group that success in this field depends upon volume operation and highly efficient shop techniques; urged those already in or planning to enter this field to look for new markets to build up volume and review their shop operations with an eye to improved and more efficient methods.

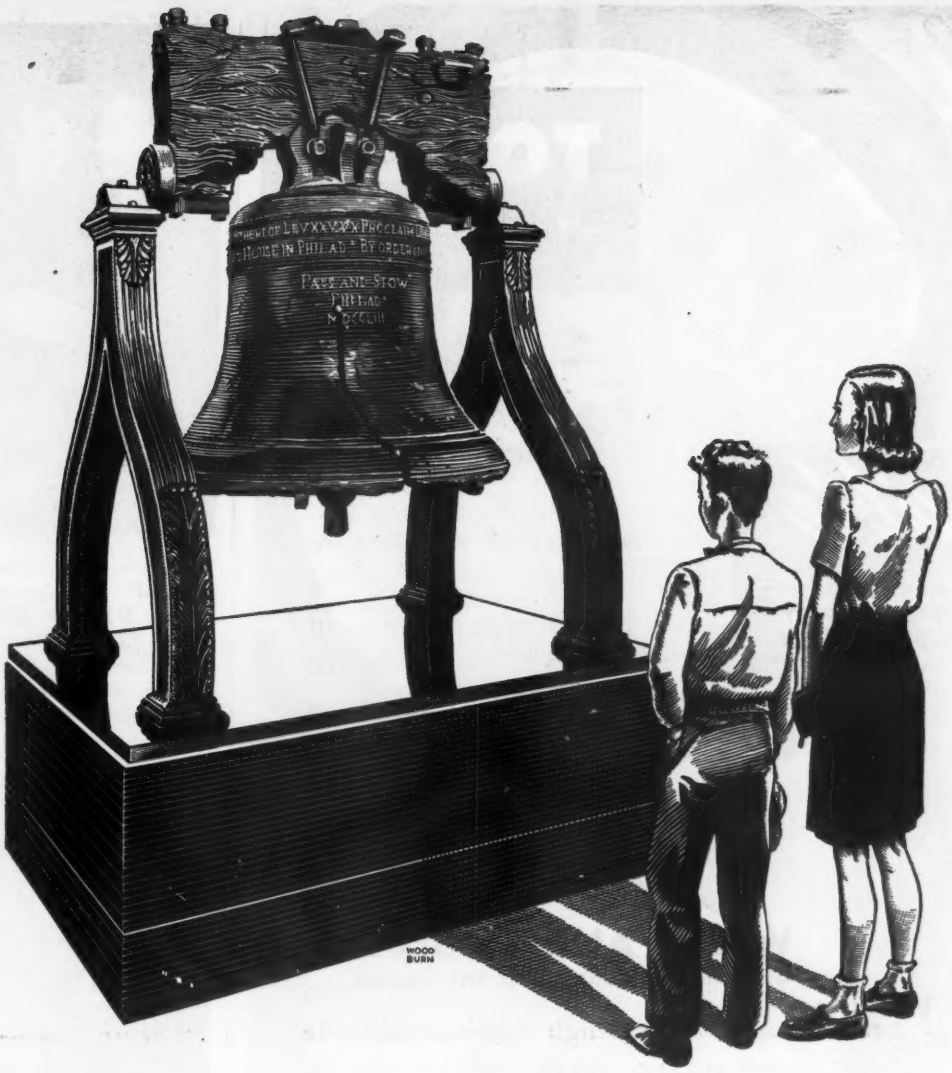
Joseph H. Previty, Penn Electric Motor Co., Philadelphia, reiterated the need for volume in small motor repair work. Previty's shop does most of its volume with refrigeration service shops; finds warranty work can be quite a problem. Excellent customer relationship and reduction in number of "comebacks" has resulted from an educational program Previty promotes with his refrigeration service customers. He provides them with a complete report of findings on all warranty jobs; holds pre-arranged meetings with refrigeration servicemen at which motor installation, maintenance, overload causes and indications, and motor failure causes are outlined and

Wm. J. Wheeler, The Maintenance Co., New York; John E. Launder, Independent Electric Machinery Co., Kansas City, Mo.; Selden F. High, The Sullivan Electric Co., Cincinnati, Ohio; J. Roland Stolzenbach, The Roland Electrical Co., Baltimore, Maryland.

Roy Spaulding and George Glenning, Spaulding Electric Co., Detroit, at roster of NISA convention registrants.

discussed. Shop movies and shop tours complete the program. Result: Penn Electric has sold its service and convinced customers that a repaired motor can equal performance of a new one, Previty revealed.

Reports of motor manufacturer representatives indicated that their authorized service shop policies are working to the mutual advantage of all parties concerned. In general, warranty work is done at competitive price levels. B. L. Britt, manager, electrical service department, Wagner Electric Co., St. Louis, emphasized the importance of diagnostic "know-how", good testing and repair equipment and ability of authorized service shops to get along with people. F. J. Gieger, Allis-Chalmers Mfg. Co., Norwood, Ohio, cited the unusually prompt service offered by motor shops; revealed that Allis-Chalmers now has about 65 authorized service shops throughout the country. G. E. Tenney, Lincoln Electric Co., reported that Lincoln now has 132 authorized service shops (106 in this country) compared to 14 last year; revealed that 86 of those in this country are NISA members, estimated a



What price liberty?

IT was Daniel Webster who said, "God grants liberty only to those who love it and are always ready to guard and defend it."

Today in our yearning for "security", we are inclined to forget about that "liberty" for which this old bell rang out. The two are not synonymous. When we permit a benevolent government to assume more and more responsibility for housing, feeding, hospitalizing, and even entertaining our citizens, we must in return expect to surrender more and more of our personal rights and liberties.

Actually, the only security any man can enjoy with liberty is the security he earns through his own initiative, resourcefulness and productivity. As community leaders, it is our responsibility to help our fellow citizens realize that for the delusion of government-guaranteed security they are sacrificing liberty.

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Taking notes from "Equipment Wanted" postings at convention are: (L to R) Roy Kornfeld, Kornfeld-Thorp Electric Co., Kansas City, Mo.; David Sandman, Sandman Electric Co., Boston, Mass.; and J. J. Reddington, J. J. Reddington Electric Service, Boston.

Frank W. Sloan, California Electric Works, San Diego; and W. E. Brunson, Sumter Electric Rewind Co., Sumter, South Carolina.

potential for Lincoln authorized shops of $5½ millions.

Shop Cost Reduction

Shop management has a sharp focus on efficiency and cost reduction. What is being done in some shops was revealed in papers presented by Joseph W. Cavataio, Illinois Electric Works, Inc., East St. Louis, Ill.; and J. Arthur Turner, Tampa Armature Works, Inc., Tampa, Florida; also in management forum sessions.

Mr. Cavataio has cut office material costing time for volume motor repairs down 50% and saved considerable mechanics time by setting up table of average material cost figures for motors up to 25 hp. in size. These figures are based on detailed cost data gained

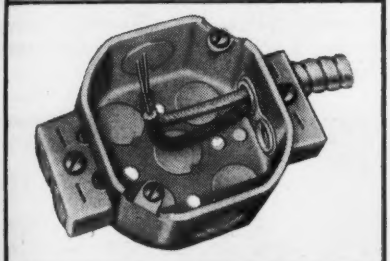
Here's the ONE Box with MANY APPLICATIONS...

RACO Jay Kay*

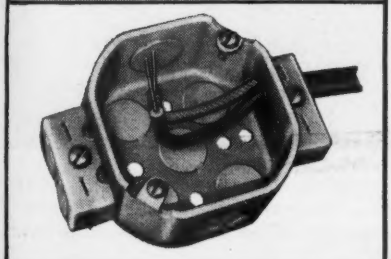
The *ALL-PURPOSE* CABLE BOX

The "JAY-KAY" is back! The multiple purpose box is *in stock and available for immediate shipment.* ORDER IT NOW—for use with BX or FLEX—it accommodates either type quickly and efficiently. It's the *every purpose* box. Saves labor—external clamps not only provide more room within box, but speed assembly and installations.

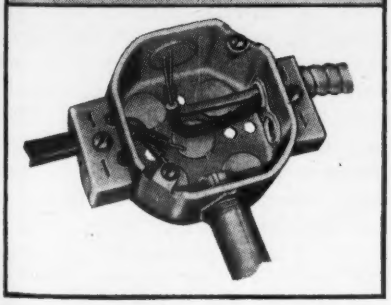
USE WITH BX



OR WITH FLEX



OR WITH PIPE AND BX OR FLEX

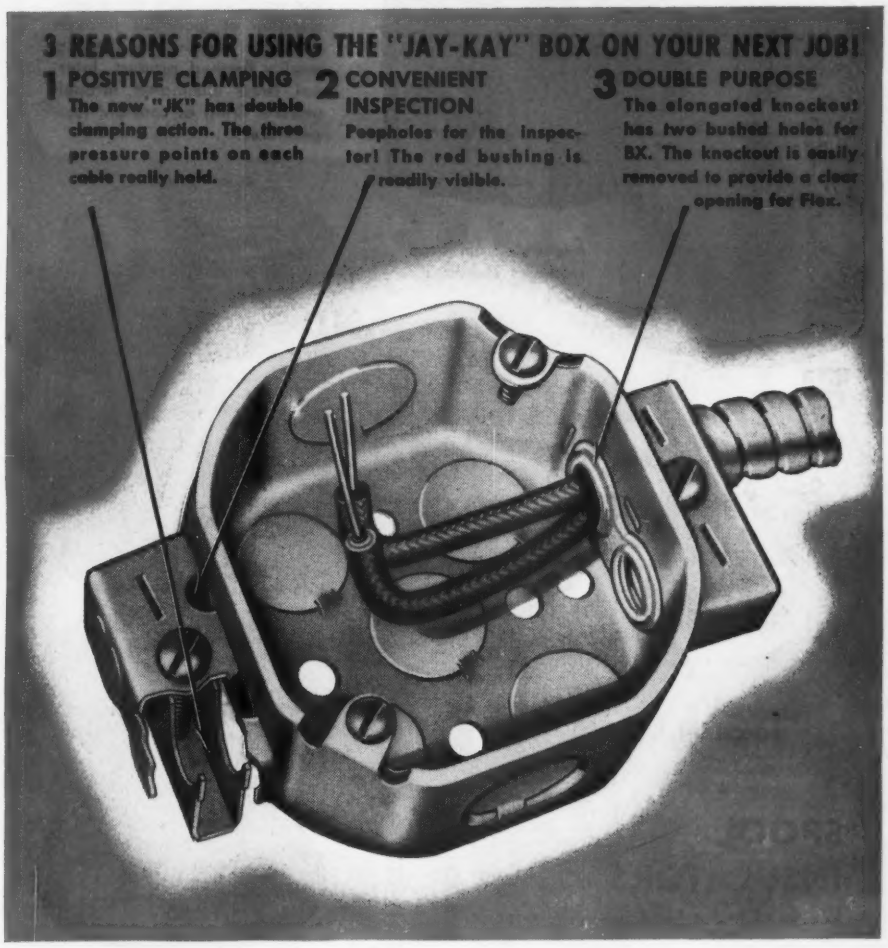


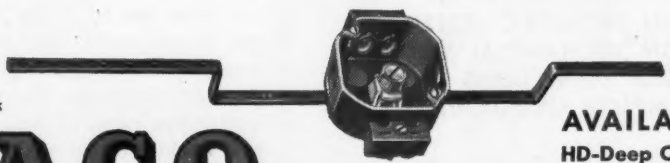
3 REASONS FOR USING THE "JAY-KAY" BOX ON YOUR NEXT JOB!

1 POSITIVE CLAMPING The new "JK" has double clamping action. The three pressure points on each cable really hold.

2 CONVENIENT INSPECTION Peepholes for the inspector! The red bushing is readily visible.

3 DOUBLE PURPOSE The elongated knockout has two bushed holes for BX. The knockout is easily removed to provide a clear opening for Flex.





"JAY-KAY" BOXES ARE AVAILABLE ON BAR HANGERS, TOO!

HD-Deep Offset HS-Shallow Offset HSS-¾" Offset

*Reg. Trade Mark

RACO

ALL STEEL PRODUCTS

A Box for Every Need

ALL-STEEL EQUIPMENT INC.

600 KENSINGTON AVENUE • AURORA, ILLINOIS

J. Arthur Turner, Tampa Armature Works, Tampa, Fla.; Wm. S. Giles, Giles Armature & Electric Works, Marion, Ill.; F. J. Gieger, Allis-Chalmers Mfg. Co., Norwood, Ohio; V. R. Woodard, exec.-sec'y., Southwestern Chapter, NISA, Ft. Worth, Texas; Charles C. French, French-Gerleman Electric Co., St. Louis.

Rudolph A. Scherer, Scherer Electric Co., Indianapolis, Ind.; and Lynn F. Hummel, Glow Electric Co., Cincinnati, Ohio.

over years of experience, check favorably with other shop experience; include all material used in rewinding stators as well as varnish and baking costs. After using this method for four years, Cavataio finds he cannot justify the old method of detailed material listing; urged NISA to appoint a committee to gather and release to members National average cost figures as well as high and low limits.

Mr. Turner presented time study data for rewinding 3-phase, 60-cycle, 220/440/550-volt, NEMA frame motors from one to 25 hp., in 2, 4, 6, 8, and 10-pole units. Man-hour data was based on experience in his shop and data received by the NISA engineering department from 12 well equipped and well managed member shops. Included in the table are total time and breakdown columns for all phases of work comprising a complete rewind job. Turner urged shops to post this table as a guide to their shop men; suggested that blank forms be filled in on actual rewind jobs. Additional efficiency ideas

Want to START SOMETHING?

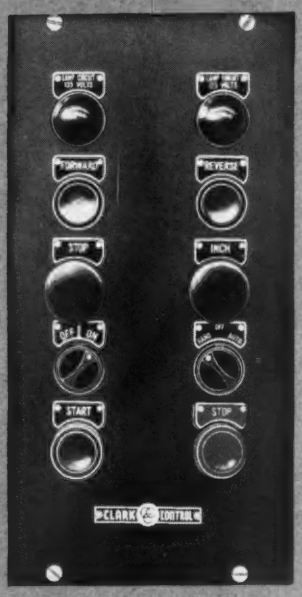
Use Clark Push Buttons and Motor Starters!

Clark Push Buttons are available in enclosures from 1 to 9 units in a row, and 10 units in 2 rows. Pendant and oil tight buttons are particularly adapted to machine tool or other applications where oily conditions prevail. "RN" and "RNG" are in heavy cast cases, for operation by hand, foot, or tongs—frequently used as foot switches.

Type "D" buttons are for Heavy Duty use; Type "DB" and "EE" are for standard applications.

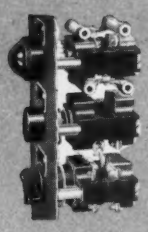
For your Push Button, Pilot Light or Selector Switch applications, there's a Clark Unit available.

BUL. 100, PENDANT PUSH BUTTON STATION, TYPE D

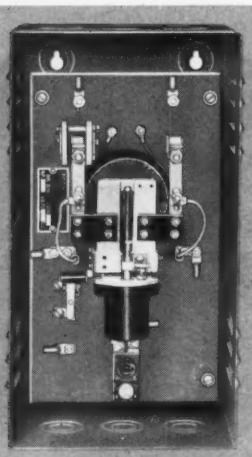


BUL. 100, TEN UNIT, 2 ROW PUSH BUTTON STATION, TYPE D

BUL. 100, START-STOP PUSH BUTTON STATION, TYPE D



BUL. 100, PILOT LIGHT PUSH BUTTON AND SELECTOR SWITCH BACK OF PANEL MOUNTED



BUL. 5360, MAGNETIC, REDUCED VOLTAGE, NON-JOGGING, D.C. STARTER

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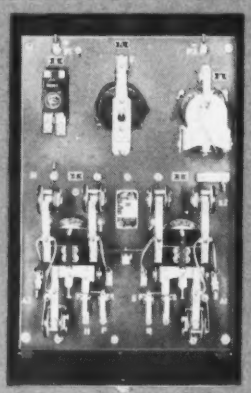
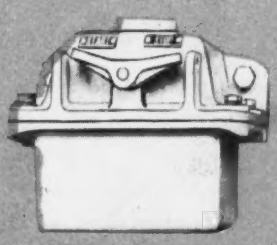
See next page for A. C. STARTERS

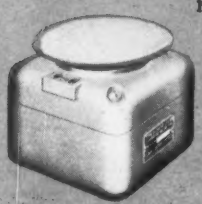


BUL. 5370, REVERSING, DYNAMIC BRAKING D.C. STARTER

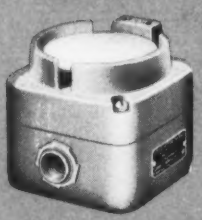
BUL. 100, DUST TIGHT (NEMA IC 50-28) or WATER-TIGHT (NEMA IC 50-43) PUSH BUTTON STATION, TYPE D



BUL. 100, PUSH BUTTON STATION FOR CLASS 1, GROUP D, HAZARDOUS LOCATIONS, AIR-BREAK, OR OIL-IMMERSED



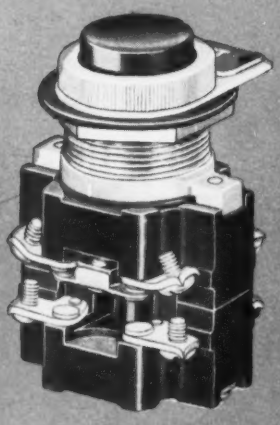
BUL. 100, TYPE "RN" PUSH BUTTON



BUL. 100, TYPE "RNG" PUSH BUTTON

BUL. 100, TYPE "DB" PUSH BUTTON

BUL. 100, TYPE "EE" PUSH BUTTON



BUL. 100, OIL TIGHT PUSH BUTTON, TYPE D

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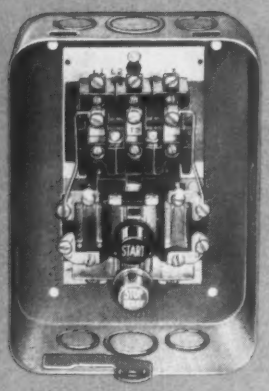
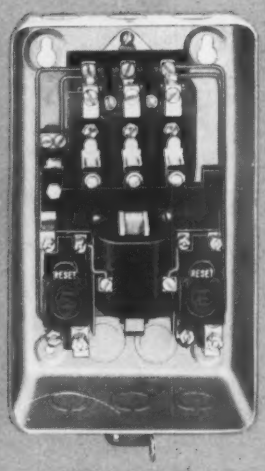
● Clark A. C. Motor Starters are designed for heavy duty service in all types of industry. Available in open types, and in cabinets to suit normal, dust, moisture, or hazardous conditions, and with many modifications to adapt them to varied special applications. The many thousands in satisfactory use attest their value to industry.



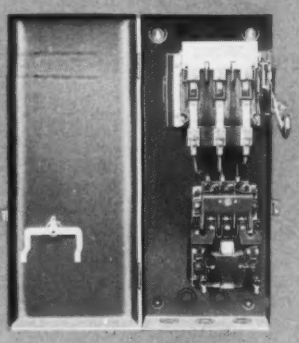
BUL. 6002, MANUAL STARTER

Call Your **CLARK** *Distributor*

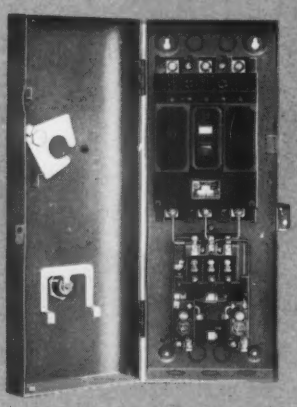
See other side for PUSH BUTTONS AND D. C. STARTERS



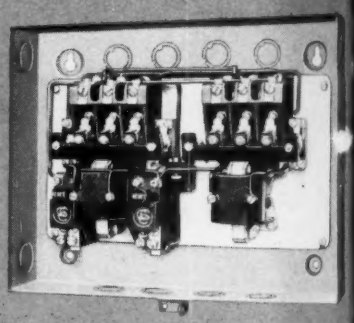
BUL. 6013, MAGNETIC, NON-REVERSING STARTER



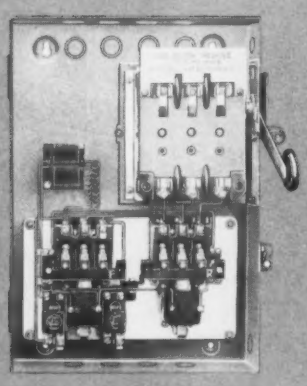
BUL. 6018, MAGNETIC, NON-REVERSING COMBINATION STARTER, WITH DISCONNECT SWITCH



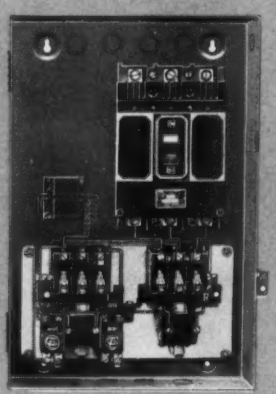
BUL. 6020, MAGNETIC, NON-REVERSING COMBINATION STARTER WITH CIRCUIT BREAKER



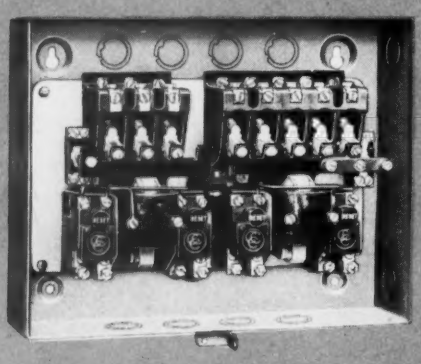
BUL. 6030, MAGNETIC, REVERSING STARTER



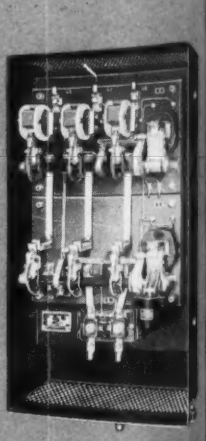
BUL. 6038, MAGNETIC, REVERSING COMBINATION STARTER WITH DISCONNECT SWITCH



BUL. 6040, MAGNETIC, REVERSING, COMBINATION STARTER WITH CIRCUIT BREAKER



BUL. 6050, MAGNETIC, MULTI-SPEED STARTER



BUL. 6080, MAGNETIC PRIMARY RESISTOR STARTER

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S. J. Stewart, Stewart Electric, New Orleans, La.; and B. C. T. Elworthy, Elworthy & Co., Ltd., Vancouver, British Columbia.

Representing Electric Motor Repair Co., Cedar Rapids, Iowa, at NISA convention were F. C. Holecek, shop foreman and Jerry Fottral, in charge of sales and purchases.

offered by Mr. Turner included: A well qualified man to do *all* testing; modern equipment; departmentalization; standardization of winding operations; specialization of mechanics to wind different types of apparatus.

At the various forum sessions, similar ideas on departmentalization, operating cost reduction and efficient shop techniques were exchanged. Discussions of "overhead" and the hazard of high overhead burden on a receding volume curve were pronounced and extensive. Shop management is exhibiting deep concern over the pricing, discount, and consignment policies of motor manufacturers and its relationship to the motor service shop business. Price cutting as a means of increasing volume was vetoed by shop operators in favor of an aggressive promotion program to sell their "know-how," service, and quality workmanship to the customers.

New to NISA convention agenda was the subject of transformer repairs. Such a business activity cannot be lo-

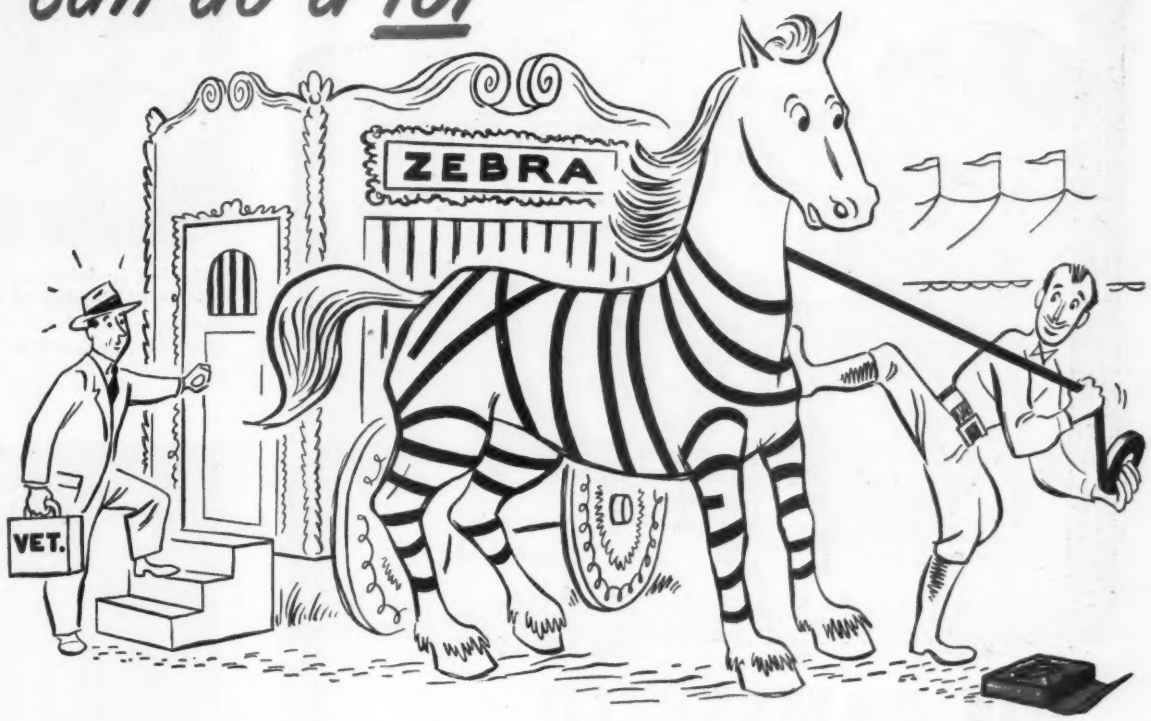
W. S. McClure, supt., polyphase dept.; and C. V. Epting, general manager, Jones Electric Repair Co., Charlotte, North Carolina.

N. Wheeler, Clark Controller Co. (Chicago); Lester L. Luton, Luton Electric Service, Ada, Okla.; Arthur Hendrickson, Duncan Electric Co., Duncan, Oklahoma.

calized, but must cover an adequate area to maintain volume, stated C. J. Covington, Dowzer Machinery Works, Inc., Mt. Vernon, Ill. Logical customers are industrials, municipal plants, REA Co-ops, and power companies. To be profitable and competitive, such an operation should gross about $5,000 per month, he added. Covington pointed out the lack of skilled and technically trained employees; scored the lack of support and cooperation of most transformer shops; urged liberal and unselfish exchange of ideas and development of a transformer rewind data service in NISA; suggested strict adherence to the NISA Transformer Rebuilding Standards.

In a prepared paper, Homer Hull, Manager, Turner Electric Works, Jacksonville, Florida, reiterated the need for volume in transformer repair work, at least 100 units per month. A well equipped shop with modern equipment and time-saving layout is essential, he continued. Investment in equipment and materials (excluding shop building which was leased) for a ca-

You can do a lot



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That's one of the first things you notice about Gold Seal Tape—*it goes further.* There's more tape value in every roll because there's no waste.

Laboratory controlled production assures lasting "tack" in the friction compound. Gold Seal will not dry out or peel. Its top quality base cloth tears evenly, quickly, without raveling.

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FRICTION and RUBBER TAPES

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Relaxing in lobby at NISA convention are David Gordon, J. E. Berger Corp., Detroit; and J. F. DeBolt, National Electric Service Co., St. Louis, Missouri.

From Texas were: (L to R) J. M. Morgan and Aileen Morgan, Central Electric Co., Ft. Worth; Paul V. Bush, Lubbock Electric Co., Lubbock; C. E. Phillips, Savage-Phillips Electric Co., Wichita Falls; and C. T. Cline, Insulation & Wires, Inc., Ft. Worth.

pacity of 150 transformers per month totaled some $34,000, Hull revealed. In addition to this there is generally 10 to 15 thousand dollars in work in progress and accounts receivable. To head such an operation you need a well experienced, capable person with engineering training and ability. Well trained production workers can handle the dismantling, winding, and assembling operations, he concluded.

Mrs. E. J. Atkinson, The Atkinson Armature Works, Pittsburg, Kansas, outlined the steps her shop took to design and manufacture dry-type, air-cooled auto-transformers.

Walter B. Meyer, secretary, American Metallizing Contractors Association and manager, Metallizing Division, John Nooter Boiler Works Co., St. Louis, outlined the basic principles of metal spraying; urged shop operators to carefully study the process and technique; warned against ill advised employment and promotion of the process.

The formal sessions closed on a note of "quality workmanship" provided by C. C. French, French-Gerleman Elec-

Discussing used equipment market at NISA convention are Garrett Lea, Lea Electrical Equipment Co., Chicago; and M. Friedkin, Electric Enterprise Co., New York City.

Watching motor winder James Pettyplace, Henry Electric Co., Saginaw, Mich., install coils in stator are Roy Austin, (left) Muncie, Ind., manufacturer of the Motorcraft stator holder, and L. L. Egleston (right), Egleston Electric Co., Marshalltown, Iowa.

tric Co., St. Louis. Motor shops must not only sell but *provide* improved service and quality workmanship, he warned. Motor shops cannot afford to undersell each other on the basis of lowest price and "cheap" work just to get business. Service should be on the basis of better and improved quality and longer lasting repairs. Constructive selling and customer education on value of "quality" is needed, he added. To illustrate his points, Mr. French showed comparison slides of "horrible example" and "quality" workmanship on motor repairs.

Forum sessions on management, large motor problems, small motors, and open discussion were held on two afternoons during the conference.

At the business session, a membership committee report showed an increase of 158 (including 11 associate) new members during the past year. Total membership now is 1,005 motor shops.

New officers of the National Industrial Service Association are: President—R. E. Ward, Raleigh, N. C.; vice-president—H. Ed Grant, Nash-

Among Westinghouse Electric Corp. representatives at NISA convention in St. Louis were: (L to R) E. Dodd, St. Louis repair shop; R. M. Atwood, Sharon Transformer Div., Sharon, Pa; and L. Richards of the St. Louis repair division.

G. E. Gillette, sales engineer, Mica Insulator Co., St. Louis; and G. E. Phares, transformer specialist, Southwest Electric Co., Oklahoma City, Oklahoma.

ville, Tenn.; secretary—M. F. Zack, Mason City, Iowa; treasurer—C. R. Durand, Allentown, Pa.

Fred B. Wipperman, St. Louis is the executive-secretary and Ward Rust, St. Louis, NISA engineer. Newly elected directors are: Alfred Elson, Jr., Pawtucket, R. I.; H. Ed Grant, Nashville, Tenn.; and Wm. S. Giles, Marion, Ill. F. M. Mielke, Duluth, Minn. succeeds George P. Svendsen as director in Region 10; G. E. Jones, Amarillo, Tex. succeeds F. T. Foshee in Region 13.

Between sessions, registrants visited the exhibit hall where some 25 manufacturers and manufacturers' representatives displayed motors, controls, current and voltage protective devices, carbon brushes, insulating materials and general shop equipment. The 1950 convention will be in Boston.

Engaged in pre-session chat at NISA convention are: (L to R) A. O. Kleen, Electric Service Co., Inc., Austin, Texas; W. W. (Herb) Michael, Michael Electric Co., Ft. Worth, Texas; and M. E. Cole, Insulation & Wires, Inc., Houston, Texas.

J. S. T. McDowell, Longview Electric Motor Co., Longview, Texas (who flew to the convention in his own plane) chats with J. H. Spence (right), Hussman Refrigeration Co., St. Louis.

Maillard Heads Indianapolis League

Albert L. Maillard, managing director, Electrical League of Indianapolis Inc., was re-elected president of the organization for the ensuing year. Other officers chosen to serve with Maillard are: vice-president—C. H. Domhoff, Guarantee Tire & Rubber Co.; secretary—H. H. Bauck, Adams & Co.; assistant-secretary—Louis Randle, Associated Distributors, Inc.; treasurer—O. T. Fitzwater; assistant-treasurer—W. J. Morgan, Westinghouse Electric Corporation.

Representing the various industry groups on the Board of Directors are: Appliance Dealers—R. B. Ludlow; Appliance Distributors—Hayes Holli-

A. C. Lackore, Lackore Electric Motor Repair, Winona, Minn.; Albert E. Ott, The Hoover Company, North Plainfield, N. J.; and Fred G. Davenport, Lackore Electric Motor Repair, La-Crosse, Wisconsin.

Gordon McIntyre, Dow-Corning Corp., Midland, Mich., discusses silicones with John E. Urban, Reliance Electric Co., Perth Amboy, New Jersey.

baugh; Contractors—H. W. Claffey; Manufacturers—Fred Gilchrist; Motor Repair—Louis Jonas; Oil Heating—F. J. Schuster; Service and Maintenance—G. W. Kintner; Supply Distributors—Tom Beecher; Utilities—A. C. Crandall.

Members of the Wiring Committee are: Walter Meyers, chairman; Tom Everhard, vice-chairman; James Crump, Charles Coonce, A. C. Crandall, Frank Reynolds and Emmett Vincent.

Medsker Heads Detroit Motor Shops

Cecil R. Medsker, Miller-Seldon Electric Co., Detroit, was elected president of the Great Lakes Chapter, National Industrial Service Association at the recent annual election of officers of that group. Other officers elected at

M. F. Zack, Zack Brothers Electric, Mason City, Ia.; and Earl H. Wheat, Wheat's Electric Motor Repair, Watertown, S. D., check short-circuiting device puller with Harold H. Morben, H. A. Holden Co., Minneapolis, Minn.

Stanley Kroell, Kroell Electric Co., Canton, Ill.; and E. B. Conrad, Barkley Electric Co., Cincinnati, Ohio.

that time were: Vice-President—Don H. Blackburn, Don Blackburn & Co.; treasurer—Charles H. Howard, Howard Electric Co.; secretary—James G. Spaulding, Jr., Spaulding Electric Company—all of Detroit.

Northeast I.E.S. Meets in Hartford

The Northeastern Regional Conference of the Illuminating Engineering Society, held this year in Hartford, Connecticut, presented a comprehensive and informative program for the delegates from the New York, New England and Connecticut Sections on May 12th and 13th. Speaking during the three general and five technical sessions held in Centinel Hill Hall of G. Fox & Company, and at the reception and dinner at the Bond Hotel in honor of I.E.S. President Lee E. Taylor, a total of 33 Society, professional, utility, ed-

I.E.S. Vice President Walter Sturrock, General Electric Co., Cleveland, Ohio; Myrtle Fahsbender, Westinghouse Electric Corp., Bloomfield, N. J.; and Richard G. Slauer, Sylvania Electric Products, Inc., Salem, Mass., highlighted the opening session at Hartford.

ucational, industrial and legislative representatives addressed the gatherings. Of particular interest were reports by President Taylor and I.E.S. Technical Director C. L. Crouch; technical discussions of Gaseous Tube Sources, ballast and operating equipment, and the use of Plastics for Lighting, as well as technical symposiums on Store, Industrial, Residential, School and Highway Lighting.

President Taylor stressed the growing scope of both the national and local Society activities, stating that, "The regional programs now surpass in scope the activities of the national organization of a decade ago." In mentioning the professional status of I.E.S. members, he pointed out that Professional Engineering examinations are now required in 47 states, three U. S. Territories and the Dominion of Canada, and urged all I.E.S. members who are qualified for P.E. status to apply for this recognition.

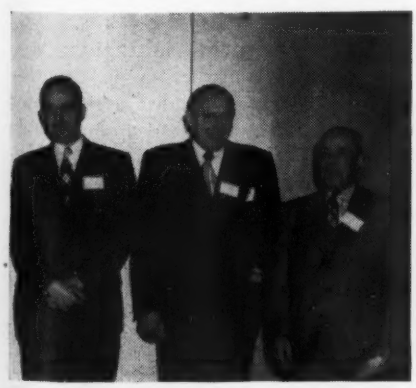
"What The I.E.S. Is Doing For You", was the topic of C. L. Crouch, who outlined the contributions being made to the lighting industry by the Society's 80 standing committees. Airport, highway, farm, hotel and television research programs were among the many committee projects outlined.

Keynoting the opening session, I.E.S. Vice President Walter Sturrock discussed the Society's regional formation and the purpose of local conferences, stating that "many outstanding papers, presented at the national technical conference each year, receive wider and more serviceable dissemination by these means, and many additional technical studies, equally valuable yet too numerous to be included on the national conference agenda, can be given merited recognition and attention at the regional gatherings."

R. D. Cutler, vice president of the Hartford Electric Light Co., officially welcomed the delegates by also emphasizing the importance of sharing practical knowledge for, he said, "changing trends in lighting have created a demand for design specialists, for the custom lighting installation of today must conform to specific objectives, applications and locations."

In looking forward to "Horizons In Lighting", Richard G. Slauer, Sylvania Electric Products, Inc., discussed footcandles in terms of levels of intensity, standards and engineering. To illustrate, he mentioned that, "big-league baseball is doing an outstanding sales-promotion job for high-level lighting, improving the enjoyment of the spectator and the playing ability of the teams. And it presents a challenge to other industries to likewise recognize the value of higher illumination levels. It should be recognized, however, that levels above 100 footcandles should not be recommended without considering the related problems of glare, contrast, brightness, color, distribution and economics." In commenting on the occasional criticism created by the increasing variety of available lamps, Slauer defended the selection by stating that, "a study of existing lamps shows that each one is an attempt to solve a particular problem of color, shape, circuit simplicity and other desirable features."

During the Symposium on Store Lighting, George J. Kyte of the G. Fox Company explained and demonstrated many of the lighting techniques used in the modern store auditorium. He also discussed the purpose of good store lighting, declaring that, "there are four factors to be considered: Entrances must be attractively lighted to entice customers into the store. General illumination must be sufficiently



Northeastern Regional Conference of the Illuminating Engineering Society brought together the Society's technical director C. L. Crouch; I.E.S. national president Lee E. Taylor, Detroit Edison Company; and regional vice president G. W. Beals of The Miller Company.

Kenneth E. Estler, Holophane Co.; James C. Forbes, General Electric Co.; and James M. Shute, Bachmann Uxbridge Worsted Corp.; addressed the I.E.S. Hartford Conference on related industrial lighting applications.

high to clearly display the merchandise. Accent lighting must focus the buyers' attentions on specialties. And lighting in all areas must be comfortable so that the customers will wish to linger."

Frederick A. Rode, representing Edward E. Ashley, Consulting Engineer, added that flexibility was equally important so that area atmospheres could be shifted with the seasons. Proving his thesis by examples, Rode also mentioned many practical installational kinks, operational procedures and economic standards by which to estimate the cost of modernizing the lighting in existing mercantile structures.

Wentworth M. Potter, G. E. Co., added that, "small stores can create an impression of depth by building up light levels at the rear of the store. It has been said that many small establishments cannot afford good lighting. That is not the case. For the small store needs every available sales weapon to fight competition, and lighting offers the greatest promotional opportunities to those who will properly evaluate it."

Opening the Industrial Lighting session, James C. Forbes, G. E. Co., discussed six recommended systems for foundries, machine shops and assembly plants, utilizing combinations of fluorescent, mercury and filament lamps. He stated, "Industry in general definitely needs at least three times its present levels of illumination in order to bring light up to date in terms of present know-how and personal efficiency. If industry could afford 10 to 15 footcandles 15 years ago, it can well afford 40 or more footcandles now without violating pro-rata operating costs."

Kenneth E. Estler, Holophane Co., Inc., stressed the importance of utilizing more than a single type of light in high-bay areas, presenting typical problems and solutions for estimating the

requirements of vapor and incandescent units, and explaining the use of the Holophane Calculux. He compared open and closed units in terms of efficiency and maintenance economics, and stressed the importance of specifying lighting installations adequate to compete with normal light absorption and interception by equipment and personnel in the shops.

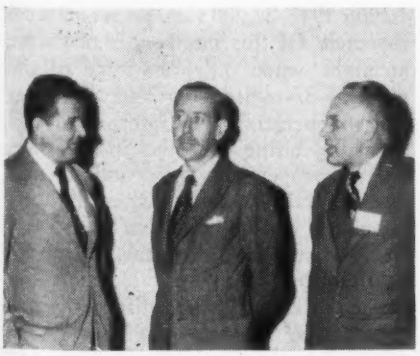
L. E. Whitmoyer, E. I. du Pont de Nemours & Co., Inc., presented the color thinking of the colorist, physicist and psychologist, analyzing problems connected with the color of food, psychological reactions, the creation of desired mental atmospheres and suggesting temperatures to the workers.

Initiating the Residence Lighting Symposium, Jan Reynolds, Sylvania, presented an illustrated talk on "Trends in Home Lighting", touching on built-in lighting for bookcases, coves, valances and kitchen cabinets, and devoting particular attention to incidental lighting in rooms used to view television programs.

Bertha Schaeffer, Bertha Schaeffer Galleries, discussed "Color in the Home," mentioning that "architecture, decoration and lighting are closely-related fields. And all three are essential if the result is to be both functional and aesthetic and if proper color values are to be given to textiles, skin tones, wall papers, food and furnishings."

Custom lighting was discussed by Thomas S. Kelly, Thomas Smith Kelly Lighting, and emphasis was placed upon techniques used to illuminate paintings and sculpture by analyzing the intensities desired, the angle of light incidence and the available equipment.

Street and Highway Lighting should incorporate seven preliminary steps, according to Gene Ray of the Holophane Co., Inc. Accident records should be analyzed, streets should be classified



Store Lighting Symposium Chairman C. W. McCormick plans details of his program with Frederick A. Rode, representing Consulting Engineer Edward E. Ashley at the I.E.S. Hartford Conference, and Wentworth M. Potter, General Electric Co., who jointly discussed Planned Interior Sales Lighting.

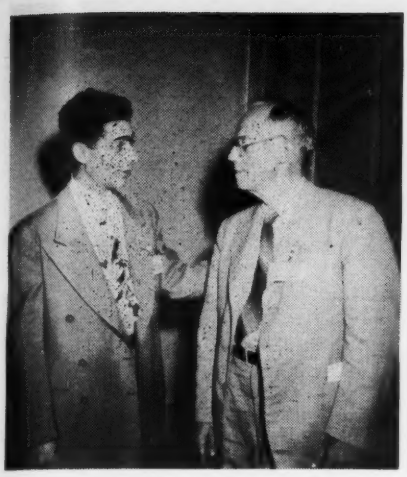
Attending NISA convention from Dothan, Alabama, were J. G. Higgins and Jim Higgins, Jr., of Higgins Electric Company.

as to traffic density and accident rates, the need for special lighting at particular points should be investigated, location points for luminaires should be determined, light distribution should be analyzed, luminaires giving this distribution should be selected, and lamp sizes should be calculated for each particular installation.

Frederick M. Spaugh, G. E. Co., added that reflectors and refractors were designed primarily to reveal silhouettes on the highway, and discussed control and lighting equipment to achieve economical results. The long-arc mercury lamp with a controlling electro magnet to centralize the arc in the tube, and the use of a photo cell control to activate lamps when daylight conditions dictated, were also stressed.

In analyzing "The Future of Street Lighting", Philip N. Clerke, Westinghouse Electric Corp., referred to the accident rate compiled in the country over the past decade, mentioning that, during 1947, 32,000 fatal accidents were reported. Of this number, 20,000 were at night when only one-third of the nation's 37-million registered vehicles are in operation. He interpreted this record by citing the losses in life, time, wages, property damage and medical costs, and declared that "street lighting should be considered as an investment in life insurance rather than as an operating cost."

School Lighting was discussed from the viewpoint of the engineer (J. L. Kilpatrick, Silvray Lighting, Inc.) and the educator (Dr. Rexford Souder, Asst. Superintendent of Schools, Brookline, Mass.). Richard Bradley, Day-Brite Lighting, Inc., then discussed "Ways and Means of Achieving Better School Lighting", by reviewing the present methods employed in design, the objectives desired and the re-



Fred S. Ferris, Northeastern Electric Co., Boston, Mass.; and W. E. Laycock, Laycock Armature Works, Tampa, Florida.

sults that can be obtained by installing existing equipment now obtainable.

In a discussion on Gaseous Tube Sources, Walter Sturrock explained the improvements which have been incorporated in the new H-1 and H-5 mercury lamps, mentioning the larger diameters of jackets and arc tubes, lower temperatures, increased life and lumen output, versatility of burning positions, and the greater survival rate of the lamps. He also discussed small or miniature, intermediate, long and shaped fluorescent lamps from the standpoints of color and intensity, comparing argon with crypton gas as to efficiency, operating voltages and lumen output.

Ernest H. Salter, Electrical Testing Laboratories, Inc., considered "Ballast and Operating Equipment", explaining the necessity for auxiliary equipment and defining the methods for stabilizing current through the use of instant start and preheat ballasts. In considering heat dissipation by convection, conduction and radiation, he spoke on proper ventilation, metal contact between ballast and fixture, required surface areas and mounting methods.

"Plastics for Lighting", by C. N. Sprankle, Sandee Mfg. Co., completed this program and explained the problems connected with thermoplastics in general, injection or compression molding and extrusion processes. In comparing the various available plastics for fixture applications, he discussed impact strength, heat distortion, shrinkage resistance, moisture absorption, rigidity, burning rate, color stability, weight and unit costs.

Session chairmen included Walter Sturrock; I.E.S. Director Myrtle Fahsbender, Westinghouse Electric Corp.; C. W. McCormick, Holophane Co.; James M. Shute, Bachmann Uxbridge Worsted Corp.; Caroline E. Horn, Electrical Testing Laboratories,

In the middle of REA construction contract revision confab is J. K. O'Shaughnessy, REA chief engineer. Getting first hand information on new clauses are Wm. J. Cagney, Jr., Evanston, Ill., and Roy Richards (right), Carrollton, Ga., director and vice-president respectively of the Rural Electrican Contractors Association.

Inc.; I.E.S. Regional Vice President G. W. Beals, The Miller Co.; Henry J. Wilson, G. E. Co.; Robert S. Newhall, The Connecticut Light and Power Co., and Roger T. Waite, Aetna Casualty and Surety Company; The late Preston S. Millar, then president of Electrical Testing Laboratories, served as toastmaster at the Thursday evening reception at which Austin D. Barney, president of the Hartford Electric Light Co. was guest speaker.

IES East Central Region Convenes

The East Central Region of the Illuminating Engineering Society, comprising the Philadelphia, Pittsburgh and Capital (Washington) Sections and Baltimore and Eastern Pennsylvania Chapters, held its annual conference in the Penn Harris Hotel, Harrisburg, Pa. June 6th and 7th, 1949. Members and guests totalling approximately 150 from these five Sections and Chapters registered for the two-day affair.

Program for the opening day consisted of a Lighting Service Forum, four speakers on a general conference session and a dinner-dance. The second day program comprised a technical School Lighting Symposium and an inter-Section and Chapter contest on "My Most Interesting Job".

The Lighting Service Forum, chairmanned by C. S. Woodside, Capital Section chairman, consisted of a report on Planned Lighting activities which have been sponsored by the elec-

trical utilities in the area embraced by each Section or Chapter. C. C. Shotwell, Philadelphia Electric Co., reported on "Planned Lighting in Philadelphia", covering the lighting promotion, training, education and results for the Atlantic City (N. J.) Electric Co., Delaware Power and Light Company, and Philadelphia Electric Co. Gordon Maize, Duquesne Light Company, reported on "Planned Lighting in Pittsburgh", covering initiation and promotion of Planned Lighting activities in Western Pennsylvania including the highly successful Planned Lighting Exposition and Conferences in Pittsburgh March 1-4, 1948. Harold V. Oerting, Potomac Electric Power Co., reported on "Planned Lighting in Washington", and J. M. Stedman, Pennsylvania Power & Light Company, in conjunction with B. D. Barr, Metropolitan Edison Co., reported on "Planned Lighting in Eastern Pennsylvania". All the Planned Lighting activities by these various electric utilities were highlighted by training programs, direct mail promotion, and cooperation with other segments of the industry such as electrical manufacturers, electrical wholesalers, electrical contractors and others. The prepared material of the Edison Eelctric Institute was used by some utilities, while others prepared their own to meet their specific requirements and local conditions.

The general session was chairmanned by Harry Restofski, Pittsburgh Section chairman. First speaker was IES president Lee E. Tayler, who talked on "The Functions of IES" and gave a report on its continued growth, the work of the technical and other committees, and some of the aims and objectives for the future. Arthur

Studying Merit Award Entries are Adam and Abe Sluis, Sluis Electric, Chicago father and son contractor combination.

C. R. Hemby, Hattiesburg, Miss., contractor witnessed Thompson hanger demonstration by T. B. Farrington, The Thompson Electric Co., Cleveland, Ohio.

A. Brainerd, Philadelphia Electric Co. illuminating engineer and president of the United States National Committee of the International Commission on Illumination gave a "Report on the International Commission on Illumination" held in Paris during the summer of 1948. James M. Ketch, General Electric Co. lighting engineer on office and school lighting presented a paper on "The Lighting of Museums and Other Public Buildings", which included suggested lighting techniques and a report on the experimental lighting system installed in the Metropolitan Museum in New York City for the purpose of studying museum lighting problems. E. W. Lampert, chairman of the Fleur-O-Lier Technical Committee described "The Fleur-O-Lier Specification and Rating".

The School Lighting Symposium was chairmanned by Geo. E. Shoemaker, chairman of the Philadelphia Section. Three talks, each devoted to a separate phase of the school lighting problem, were presented. Ralph C. Lamciano, M. D., chief ophthalmologist for the Philadelphia Board of Education, discussed the "Prevalence of Defective Vision in Pennsylvania". Marshall Ziv, of National Chemical and Manufacturing Co., Chicago, Ill., told about the "Effect of Color in the Class Room", reporting further on the research of Dr. Darrell B. Harmon, University of Texas. Wm. H. Kahler, Westinghouse Electric Corporation, Cleveland, and member of the IES Committee on Lighting for Education, explained the "American Recommended Practice of School Lighting", and showed various lighting layouts for typical school classrooms on slides, comparing expected lighting results.

During the Society fiscal year each Section and Chapter held a contest between local members on "My Most Interesting (Lighting) Job". Winners in these five local contests then competed in the Conference contest. G. Harmon Bronner, illuminating engineer, Consolidated Gas & Electric Co., Baltimore, represented the Baltimore Chapter with a presentation of an office lighting installation at the Gunther Brewing Company, Baltimore. G. W. Wagner, application engineer, Lighting Application Section, Philadelphia Electric Co., represented the Philadelphia Section with a presentation of gymnasium lighting in the Palestra, University of Pennsylvania, designed to permit television broadcast and the taking of 35 mm. moving pictures of games in action. Leo H. Cleary, consulting engineer of Washington, D. C., represented the Capital Section with a presentation of the relighting of Stocket-Fiske Stationery Co's. store in Washington, D. C. H. J. Krietzberger, lighting engineer with Pennsylvania Power & Light Co. represented the Eastern Pennsylvania Chapter with a presentation of residence lighting of a library and oil paintings in the living room of a private home. H. S. James, lighting engineer for Duquesne Light Co. represented the Pittsburgh Section with a presentation covering the relighting of Peoples City Bank, McKeesport, Pa.

A Committee of three judges announced H. S. James as winner of the contest, "My Most Interesting Job", based on the relighting of the Peoples City Bank job, covered by his presentation.

Under the chairmanship of Harry

Post session huddle on lighting applications at recent all-industry convention in Minneapolis is held by: (L to R) O. E. Peltola, engineer, Peltola Electric Co., Mankato, Minn.; R. J. Salfer, Mankato Electric Co.; and Art Erickson, Charles A. Anderson Co., Minneapolis lighting fixture jobbers.

Charles Hamer, H. L. Hamer Electric Co., Lake Forest, Ill., watches C. R. Burt, Sangamo Electric Co., Springfield, Ill., demonstrate new electric timer.

Grattan, Jr., IES Regional Vice President in the East Central Region, and illuminating engineer for the Potomac Electric Power Company, Washington, D. C., the Conference Committee prepared its conference program around timely topics and, in the main, selected local speakers from the five local Sections and Chapters. It is believed that this local participation accounted for the high degree of interest shown in the entire program, and for the practically full attendance at each session.

Jos. J. Schuchert, Duquesne Light Co., Pittsburgh, becomes Regional Vice President of the IES East Central Region next Oct. 1st, for a three year term.

Leisurely huddle between sessions at recent NCEI all-industry conference in Minneapolis finds (L to R) Vince Guggenberger and S. J. Muggli, Cold Spring Electric Co., Cold Spring, Minn.; and E. H. Fillbrandt, Winthrop, Minn., electrical contractor discussing institutional wiring techniques.

H. R. Greene, Day-Brite Lighting, Inc., explains new fixtures to L. R. Fohl (right), Hilscher-Clarke Electric Co., Canton, Ohio.

Building Contracts Show Mixed Trend

F. W. Dodge Corporation reported recently that contracts awarded for buildings, public works and public utilities projects in the 37 states east of the Rocky Mountains in April amounted to $842,586,000 to show a 13 percent gain over March and a decline of 4 percent from April of last year.

Increased investment commitments were reported in commercial building, educational and science building, hospital and institutional building, social and recreational building, and single-family houses built to owners' orders for their own occupancy, last month's totals in these groups being higher than those for March and for April of last

At RECA meeting in Chicago, Stuart C. Irby, Jr. (left), Irby Construction Co., Jackson Miss., checks new materials developments with Kemp Haythorne, manager, new products development, U. S. Rubber Co., New York.

E. M. Reid, Benjamin Milwaukee representative (left) with W. G. Shier and journeyman Holm Pederson of Crafts, Inc., Manitowoc, Wisconsin.

year. Awards for public works were also in the ascendency during the month.

At the month's end, the cumulative record for the year in all building and engineering classifications showed a total of $2,641,656,000 or 8 percent less than the total reported for the corresponding four months of last year.

The deficit for the first four months was brought about by an over-all decline in nonresidential contract commitments of 1 percent to a total of $1,087,589,000 a decline of 17 percent in residential awards to a total of $907,796,000, and a decrease in public works and public utilities awards of 3 percent to a total of $646,271,000.

During the first four months, many classifications were running at a rate higher than a year ago. Those showing gains and the percentage increase over the first four months of last year follow: educational and science, 5; hospital and institutional, 3; public buildings, 96; religious buildings, 19; social and recreational, 13; dormitories, 57; single-family houses built to owners' orders for their own occupancy, 14.

Awards for building and engineering works for public account constituted 38 percent of the total of last month's contract volume, and also accounted for 38 percent of the first four months' total.

I.E.S. Elects Officers Plans Conference

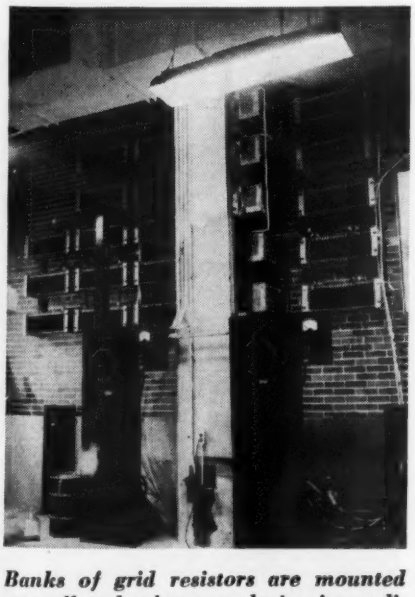
The Illuminating Engineering Society has announced the newly elected officers who will take office on October 1st, 1949, as consisting of Charles H. Goddard, Sylvania Electric Products Inc., Ipswich, Mass., as president; S. G. Hibben, Westinghouse Electric

Corp., Bloomfield, N. J., as vice president; E. M. Strong, Cornell University, Ithaca, N. Y., as treasurer; A. H. Manwaring, Philadelphia Electrical and Manufacturing Co., Philadelphia, Pa., as general secretary; and Duncan M. Jones, Curtis Lighting of Canada Ltd., Montreal, Que., and R. L. Biesele, Jr., Southern Methodist University, Dallas, Tex., as directors for the Society.

New Regional Vice Presidents to be installed in October are: Southern Region, Joe B. Browder, Georgia Power Co., Atlanta, Ga.; Canadian Region, G. F. Dean, Toronto Hydro-Electric System, Toronto, Ont., Southwestern Region, F. A. Covington, City Public Service Board, San Antonio, Texas; and East Central Region, J. S. Schuchert, Duquesne Light Co., Pittsburgh, Pa.

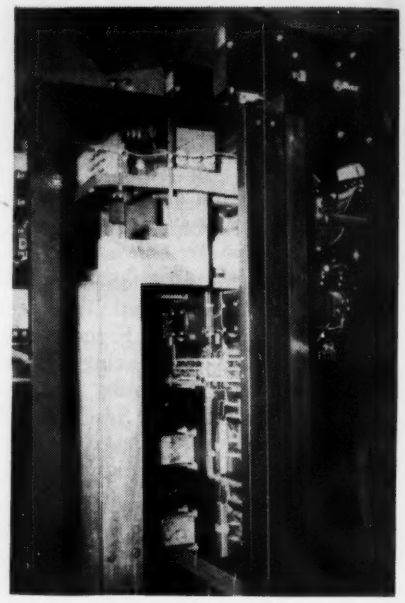
Also announced by the I.E.S. are highlights of the National Technical Conference scheduled for French Lick, Indiana, Sept. 19–23. Having an appeal to everyone in lighting and related fields, the Technical Sessions will include a variety of subjects, such as light sources, color, street lighting, residence illumination, brightness, daylight control at windows and utilization for floodlights.

This Conference sees the retirement of Lee E. Taylor, Detroit Edison Co., as president of the Society, and it will also witness the annual presentation of the I.E.S. Gold Medal and Award Certificate for "meritorious achievement conspicuously furthering the profes-



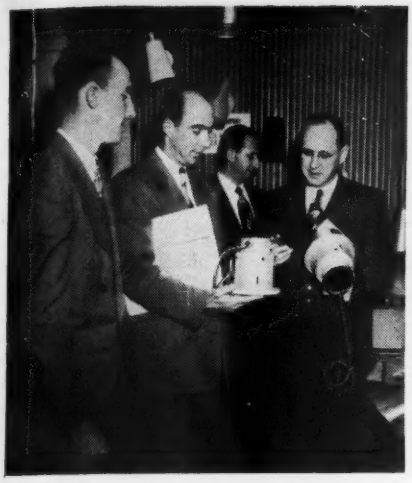
Banks of grid resistors are mounted on wall and column racks in air conditioning room of the Terrace Plaza Hotel Building in Cincinnati. Units control operation of a 700 hp. and 600 hp., wound rotor motor on two refrigeration machines. Note use of square duct to carry conductors down to rheostat control boards. Photo taken during installation by Bertke Electric Co., Inc., Cincinnati electrical contractors.

sion, art and knowledge of illuminating engineering" to Dr. Ward Harrison, retired Director of the Engineering Division of the General Electric Lamp Department, whose contributions to lighting include the design of the RLM standard reflector, the glassteel diffuser, the first cleartop semi-indirect unit and the first industrial continuous-row fluorescent installation.



Double-offset welded aluminum bus (two ½ in. by 5 in. bars) replaces conventional bolted, lap-joint copper bars in this 4,000-ampere breaker serving 2,000 kw. d-c generator on mill floor of new ALCOA plant in Davenport, Iowa. Installation by Fischbach and Moore, Inc., electrical contractors.

Drilling aluminum spacer bar for aluminum bus system. Carbon tetrachloride is used as lubricant with point of conventional drill ground down similar to that of wood bit so outer edge cuts first. Technique was used by Fischbach and Moore, Inc., electrical contractors on the ALCOA plant in Davenport, Iowa.



Marion and E. J. Conness, Lakeland Electric & Supply Co., Lake Geneva, Wis., study Hi-Hat lighting unit, demonstrated by C. R. Hower (right), General Lighting Company, New York.

Dates Ahead

International Association of Electrical Inspectors—Eastern Section, Hotel Statler, Boston, Mass., August 11-13; Western Section, Hotel Statler, St. Louis, Mo., September 26-28; Northwestern Section, Butte, Mont., October 3-5; Southwestern Section, Hotel San Diego, San Diego, Calif., October 10-12; Southern Section, Hotel Shamrock, Houston, Texas, October 17-19.

Illuminating Engineering Society—National Technical Conference, French Lick, Ind., September 19-23.

Pennsylvania Electric Association—Annual meeting, Benjamin Franklin Hotel, Philadelphia, Pa., September 20-21.

National Electronic Conference — Edgewater Beach Hotel, Chicago, Ill., September 26-27.

International Municipal Signal Association—Annual meeting, Wm. Penn Hotel, Pittsburgh, Pa., October 10-13.

National Safety Congress and Exposition—Chicago, Ill., October 24-28.

National Electrical Contractors Association—Annual convention, Rice Hotel, Houston, Texas, November 8-11.

National Electrical Manufacturers Association—Chalfonte-Haddon Hall, Atlantic City, N. J., November 13-18.

Sixth All-Industry Refrigeration & Air Conditioning Exposition—Atlantic City, N. J., November 14-18.

Plant Maintenance Show and Conference—Auditorium, Cleveland, Ohio, January 16-19.

American Society of Heating and Ventilating Engineers—Dallas, Texas, January 23-27.

Southwest Air Conditioning Exposition—Dallas, Texas, January 23-27.

American Institute of Electrical Engineers—Winter general meeting, New York, N. Y., January 30-February 3.

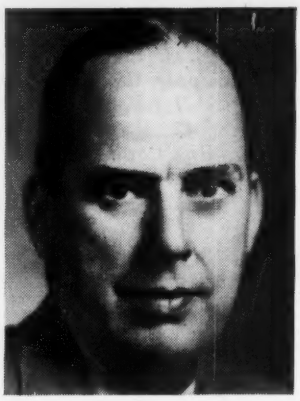
National Electrical Manufacturers Association—Edgewater Beach Hotel, Chicago, Ill., March 13-16.

Manufacturers News

WESTINGHOUSE APPOINTMENTS

The election of three new officers of the Westinghouse Electric Corporation has been announced. James H. Jewell, manager of apparatus sales, and John

J. H. JEWELL



J. M. McKIBBIN

M. McKibbin, assistant to vice president and manager of advertising and sales promotion, both of Pittsburgh were elected vice presidents. Herbert P. MacDonald, treasury manager in the company's Eastern district office in New York City, was elected assistant treasurer. He also has been appointed credit manager of Westinghouse and will make his headquarters in Pittsburgh.

The following executive changes designed to provide more adequately for the firm's expanded postwar activities and new product lines have been announced.

Vice President L. E. Osborne is assigned staff supervision over all the company's manufacturing activities, including all matters of production and industrial relations. Simultaneously he retains operating responsibility for five major manufacturing divisions.

James H. Jewell, vice president, takes over staff supervision of all sales and marketing on a company-wide basis.

John K. Hodnette, vice president and head of the transformer division at Sharon, Pa., becomes general manager of industrial products with headquarters at Pittsburgh. Reporting to him will be all operating divisions making industrial goods as well as the district sales organizations which sell these goods.

John M. McKibbin, vice president is appointed general manager of consumer products with responsibility for operation and distribution of the appliance division and the home radio division. Mr. McKibbin will make his headquarters at Pittsburgh.

G-E CHANGES

John W. Belanger, manager of the General Electric Company's turbine division at Schenectady, N. Y. and Nicholas M. DuChemin, manager of the company's meter and instrument divisions at Lynn, Mass., have been appointed assistant general managers of the G-E apparatus department. They will assist in directing operations of the department's product divisions, works service divisions and various works.

Marketing activities of the apparatus department will continue to function under the direction of Chester H. Lang, G-E vice president in charge of apparatus department sales.

Harold E. Strang, of Schenectady, engineering manager of the affiliated manufacturing companies department, has been appointed manager of the apparatus department's meter and instrument divisions at Lynn, Mass. He succeeds Nicholas M. DuChemin.

Glenn B. Warren has been appointed manager of the turbine divisions, succeeding John W. Belanger. Edwin E. Parker has been named to succeed Mr. Warren as manager of engineering of the turbine divisions.

The appointment of James H. Goss as manager of engineering in the control divisions of the apparatus department has been announced.

W. F. Rauber has been appointed manager of sales for the switchgear divisions, apparatus department. He succeeds J. D. Hoffman, who has been appointed sales manager for the air conditioning and commercial refrigeration division of the air conditioning department, Bloomfield, N. J.

The Lamp Department has created a new sales district in Tampa, Fla. and it will be headed by Douglas B. Clark.

ALLIS-CHALMERS CHANGES

Robert S. Flesheim has been promoted from manager of Allis-Chalmers electrical department to assistant to W. C. Johnson, executive vice president of the company's general machinery division. He succeeds J. D. Greensward, who has been appointed general manager of the Norwood, Ohio, works.

J. G. Schaefer has been named manager of the newly converted Youngstown district office. Formerly a branch office, it has been moved from the Mahoning Bank Bldg., to the Ohio Edison Building.

SYLVANIA APPOINTMENTS

E. W. Gutelius has been named to direct advertising and sales promotion for the lamp and fixture divisions of Sylvania Electric Products Inc.

Alfred C. Viebranz, formerly government sales representative for the Elec-

tronics Division, has been appointed special representative at Washington, D. C.

•

Colonial Electric Products, Inc. of East Paterson, N. J. has appointed the Lighting Engineering Company of Macon, Ga. as Regional Factory distributor.

•

Harry H. Lumley, Chicago district manager of operations for **American Steel & Wire Co.**, has been appointed assistant to the vice president of operations of the Wire Company. John R. Gaut, assistant manager of operations, will succeed him as Chicago district manager of operations. Mr. Lumley will continue to maintain his headquarters in Chicago.

•

Wheelco Instruments Company of Chicago, has announced the opening of a district office for the territory of Kentucky, Southwestern Ohio and Northeastern Indiana. E. C. McFaul has been named manager of the new office which is located at 307 East Fourth Street, Cincinnati.

A territory consisting of the entire state of North Carolina has been assigned to J. L. Highsmith & Company located at 111 Corcoran Street, Durham, N. C.

•

The Electric Products Company of Cleveland, Ohio, has appointed Arthur B. Sonneborn Co. as representatives for the state of Michigan and the northwestern part of Ohio. They have offices in Detroit, Grand Rapids, Flint and Toledo.

Harry J. Fisher Associates have been named representatives for most of the state of Ohio and the panhandle of West Virginia. They have offices in Cleveland and Cuyahoga Falls.

•

General Switch Corp., Brooklyn, N. Y. has named Gene Hagen & Company, St. Louis, Mo. as sales agents. Their territory includes Missouri east of Springfield, Western Kentucky, Southern Illinois and Memphis, Tenn.

Fred E. Searls, Kansas City, Mo. has been appointed sales representative and will cover Western Missouri, Iowa, Kansas and Nebraska.

•

The New York City sales office of the **Miller Company**, Meriden, Conn. has moved from 315 Fourth Avenue to 11-17 Jacob Street.

WHERE TO BUY

Equipment, Materials, Supplies and Services for Electrical Construction — Maintenance — Repairs

A GOOD Habit

The Where-to-Buy Section of Electrical Construction and Maintenance supplements other advertising in this issue with these additional announcements of products and materials of special interest and application in the field of electrical construction, maintenance and repair work. Make a habit of checking this page each issue—a *good* habit!

Ward Leonard Electric Co., Mount Vernon, N. Y. announces the appointment of Central Station Engineering Company, 2817 Croyden Drive, Tucson, Arizona, as sales representative in the state of Arizona.

•

Day-Brite Lighting, Inc. of St. Louis, Mo. has named Frank E. Brown as representative in the states of Connecticut and Rhode Island. Mr. Brown will maintain headquarters in Stratford, Conn.

•

Hykon Manufacturing Co., Alliance, Ohio, has named the L. P. Chick & Co. 405 Wallace St., Louisville, Ky. to represent them in Kentucky and Indiana; and J. R. Penning, 2323 Second Ave., Seattle, Wash. as representative in Washington and Oregon.

•

C. A. Staub has been appointed treasurer of the **Cornell-Dubilier Electric Corporation,** with headquarters in South Plainfield, N. J.

•

Charles F. Fouts has been appointed to the specialty sales staff of **Cannon Electric Development Company,** Los Angeles.

•

William C. Welde has been appointed to represent the **Western Insulated Wire Company** in eastern Pennsylvania, New Jersey, Delaware, District of Columbia, Virginia and Maryland.

•

At the last meeting of the Board of Directors of **Buchanan Electrical Products Corporation,** Arthur G. Prangley was elected president of the company. He was formerly executive vice president.

•

Homelite Corporation, Port Chester, N. Y. has announced the opening of a new branch office in Pittsburgh to cover western Pennsylvania, West Virginia and eastern Ohio. William Livingston is in charge of the new office, which is located at 810 Ridge Avenue.

•

J. G. Haskell has been appointed as a field representative of the merchandise sales, Sound Division of the **Webster Electric Company,** Racine, Wis.

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:

90c a line, minimum 4 lines. To figure advance payment count 5 average words as a line.
INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of above rate, payable in advance.
PROPOSALS, 90 cents an insertion.

INFORMATION:

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

The advertising rate is $9.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

NEW ADVERTISEMENTS received by 10 A.M., July 22nd, will appear in the issue of August, subject to limitation of space available.

EV SERIES

EXPLOSION PROOF LIGHTING FIXTURES

Appleton 52610. U.L. Approved for Class 1, Group C&D. List $19.40. Special $8.75

DOME REFLECTORS, Appleton 52811. For above Lamps. List $2.75. Only $1.10

KILLARK #ELI-100. Complete with guards and standard dome reflector $9.85

KILLARK #ELI-150. Complete with guards and standard dome reflector $10.25

All fixtures are new and in original factory package. 10% discount lots of 50 to 99, 15% discount on orders of 100 or more. We have a few bracket type lamps in 100, 150 and 200 watt sizes. Write for prices.

KLEIN CABLE GRIPS (Unused)

1628-16. Grip 5/16 to 5/8 or 300 MCM. Value $40.00. Special Price $22.50

KLEIN IMPROVED CHICAGO GRIP. 1628-5B. Handles Conductors up to ½ inch.....$9.50

KLEINS HAVEN'SSTEEL GRIP. 1604-20 .....$3.75

IDEAL FUSE PULLER SETS

1 midget, 1 pocket size—0 to 200 amps., 1 Giant 100 to 600 amps. Complete set $2.95

FUSES. Limited quantity. 400 amp. 250 volt renewable $3.50 ea. Buss 400 amp. Fusetrons..$2.45 ea. One Timers. 400 amps .....$1.95 ea.

RELIABLE STRAIGHT LINE SPLICES

Size	Price	Size	Price
21	$ .33	307	$ .77
27	.40	407	.87
101	.47	250	.97

COFFING CHAIN HOIST. Model FTG. Ratchet Type. 1½ Ton or 3 Ton. Fine for pulling cable. List $72.00. Only $52.50

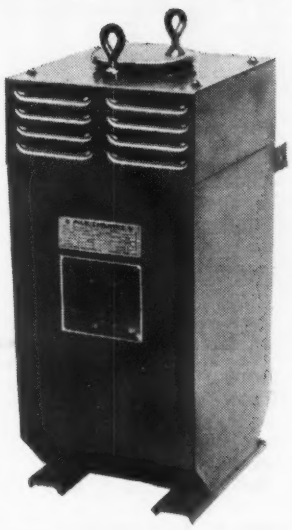
OTHER SPECIAL PRICES. 10, 12 and 14 ft. Pike Poles, Hot Line Sticks. Write.

Orders prepaid if full remittance is enclosed with order, otherwise C.O.D.

MAIN SUPPLY
523 Main St. Kans. City, Mo.

Special Offering!

2000 NEW
air cooled
—TRANSFORMERS—



• WILL OPERATE ON 220 AND 440 CIRCUITS

All transformers insulated with fiber glass; no fireproof vaults required. For lighting and power.

★ LOW PRICES ★

KVA	VOLTAGE RATING
¾ to 25	450 to 117
7½ to 25	225/450 to 117/234
PHASE CHANGERS	
15 to 50	220 or 440 to 220

MANUFACTURED BY ALLIS CHALMERS

• *Crated for immediate delivery*

AMERICAN ELECTRIC SERVICE & MAINTENANCE CO.
SPRINGFIELD, MASS.
MOTORS • GENERATORS • TRANSFORMERS • SALES • REPAIRS • RENTALS

WATTHOUR METERS

Immediate shipment from large stock

Carefully reconditioned, accurately calibrated, set to zero and guaranteed. Practically all types and sizes, single-phase, polyphase and DC. Also CT'S and demand devices. Write for bulletin.

MASPENOCK ELECTRIC LIGHT CO.
Room 731
44 Starr Lane Jamaica Plain, Mass.

FOR SALE

2—100 KW 250 volt DC Generators. Steam driven by Ball Engines—140# pressure.
1—200 KW 250 volt DC Generator. Steam driven by Ball Engine—140# pressure. Units complete with DC switchboard and two balancer sets.
1—20 ton York Vertical Ammonia Compressor. Steam driven by Corliss Engine —140# pressure.
1—15 ton York Vertical Ammonia Compressor. V belt drive. 33 H.P.—DC motor. Complete with condenser, receiver, valves, gauges, etc.
150—DC motors—various sizes.

PURITY BAKERIES
97 E. 12th St. St. Paul 1, Minn.

TRANSFORMERS CIRCUIT BREAKERS

New • Rebuilt • Rentals

1 H.P. to 2500 H.P. motors in stock
D.C., A.C., 25-50-60 Cycle

ELECTRIC EQUIPMENT CO.
49 CURLEW ST. ROCHESTER 1, N. Y.

CASH FOR YOUR SURPLUS

BUYERS OF SURPLUS COPPER INSULATED WIRES AND CABLES

No lengths too long or too short
Telephone: Eastgate 7-4778
PIERCE CABLE CO.
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